NEWS IN PERSPECTIVE

ECONOMIC CLIMATE

ECONOMIC DOWNTURN, now evident in production figures, probably will not go very deep or last very long. A basic factor of fundamental strength is the continuing high level of personal income. It continues to trend fractionally upward, though wage and salary payments tend to slow.

RECESSION TALK seems to be frightening consumers a bit. Retail sales have slackened, but not dangerously. The onset of the Christmas buying season doubtless will bring about an important reversal in the direction of retail sales. This may spur some build-up of inventories.

OVER THE YEAR, total output of goods and services will average significantly higher than in 1959, despite the current slipping tendency. The downward changes start from a high level of activity, and so far they have been minor. Psychological factors assume even greater importance in today's circumstances. This appears to be recognized, for example, by the National Association of Purchasing Agents. They note that some companies and industries are "doing very well, and while others are depressed. And, there is increasing evidence that even some of those who currently are prospering are apprehensive about the duration of their prosperity."

MANAGEMENT VIEW

"NEAR" WARNING SYSTEM, demonstrated on a systemwide (Consumers Pwr. Co.) basis in Michigan last month, "is a very wonderful vehicle to bring to people of this country a very real contribution," proposed Consumer's Pres. James H. Campbell. He added: This system can be made to work only through the medium of the electric power companies (which were represented by more than 50 participants at the Charlotte, Mich., test by OCDM).

"THE PURSUIT OF EXCELLENCE" is the way Commonwealth Edison's Pres. H. Harris Ward describes utility top management's day-to-day job. "We have to be determined we are going to have the best utility in the country--and we had better have that idea because, though we are described as a monopoly, we are in a highly competitive industry. About 90-percent of the services we provide to a homeowner could be supplied by some other form of energy," Mr. Ward observed in a recent interview.

EFFECTIVE MANPOWER UTILIZATION as one answer to the profit squeeze has been the subject of the most comprehensive analysis ever attempted in an AMA study just revealed. A first report of a continuing self-appraisal by 88 corporations with more than a million employes "provides meaningful comparisons of numbers and ratios of administrative employes, most of which produce wide and puzzling variations" company-to-company. Variations of 50-percent in manpower used to perform standard administrative tasks are common, the study shows, and variations of up to 500-percent are found. (The electric utility industry is stepping up its efforts to control manpower costs, too—see report on the EEI Industrial Relations workshop, p. 63.)

CREEPING INTEREST RATES in an inflationary economy affect utility operations in a way that many rate regulating agencies have been slow or unwilling to recognize, Michael J. Kraemer, consultant to Commonwealth Services, Inc., noted recently. If these trends persist, he predicts, the required rate on total capitalization will increase by about 1.25-percentage points in the current decade. (However, in asking the P. S.

NEWS IN PERSPECTIVE

JOINT DEVELOPMENT of Kinzua Dam, now being built by the Army Engineers on Pennsylvania's Allegheny River, has been proposed by a REA coop and a private electric company. (See page 63.)

INDUSTRY SIFTINGS

MONTH OF MILESTONES--Last month the electric power industry's achievements in technology were especially noteworthy, and all were appropriately saluted: As the world's largest generating unit (475-megawatts) was dedicated in Indiana (see p. 72), the first full-scale, privately-owned (and world's largest) nuclear powerplant was officially completed in Illinois (see p. 67); and the nation's first geothermal station was dedicated in California (see p. 66). In Pennsylvania, the world's first 460-kv transmission line was energized (see p. 63).

BUT, GENERATOR SIZE—? Up and up, of course. Last month, TWA invited bids on two 800-megawatt units. Then, how far away are the 1000-megawatt machines? —Less than 15 years, says Westinghouse Engineer C. J. Baldwin, noting that his company already has the 800-megawatt developed. (And, in Arizona Public Service next year will build the longest 345-kv transmission line in the U. S.)

"HEALTHY SPIRIT OF URGENCY" is developing over the business of selling our product to the consumer, AGA's retiring Pres. W. H. Ligon noted at the Association's recent annual convention. Competition? Plenty should come from electric utility marketers, if ideas and plans mean anything. Example: EEI's market research committee recently came up with no less than 110 ideas for "possible and needed analyses" in the industry's marketing. (See details in EL&P, Dec. 1.)

ORGANIZING PROMOTIONS—National Electrical Week (Feb. 5-11) will do it with the theme: "Make Electricity Work for You." And, the Industrial Electrification Council enters a new phase of operation, co-sponsored by both NEMA and EEI beginning Jan. 1.

DECLINING PROFITS, increasing concern of electrical manufacturers particularly, are reported by both GE (for the first nine months of '60) and Westinghouse (for the third quarter of '60). Commented GE's Chairman Cordiner: "the electrical industry is operating at not much more than half capacity, reflecting both expanded capabilities of major producers and the entrance of so many competitors."

GE STRIKE EFFECTS are undoubtedly minimized by the general supply situation in the industry. With the union position weakening as the strike progressed, prospects of utilities suffering seemed to fade, too.

MILE OF ALUMINUM TOWERS is part of a 6-mile transmission line which connects Philadelphia Electric's Eddystone plant and a substation—"first in the U. S." The utility expects to show lower total service-life costs for the all-aluminum structures than for steel towers on the line.

"DEALER DOLDRUMS" OUT is sought by Westinghouse via activities of a newly appointed National Dealer Council . . . to establish a better liaison with factory representatives and exchange information on all phases of the appliance business.

THE ATOMIC ENERGY STORY will go out forcefully to the general public on Dec. 11 in a special 16-page all-advertising supplement of the "N. Y. Times." Sponsored by General Electric, the supplement will get wide distribution in reprint form, over scores of utility company mailing lists.

HURRICANE DAMAGE COSTS, of record ($200-million) proportions in Florida after "Donna" hit, will be absorbed by Tampa Elect. Co. in its Sept. accounting period. Charging up the utility's $400,000 losses from the damage cuts earnings from 12-cents to 9-cents per common share, but that makes them the same as in the '59 period, according to Pres. MacInnes. Tampa Electric's biggest expense item?—$214,000 of overtime pay.

Industrial Relations—

Goal: Handle People As Well as Technology

Utility company representatives took stock of their progress in meeting the problems of handling people . . . and from the observations of keynote speakers addressing the recent 13th annual Roundtable Conference of the EEI Industrial Relations Committee, it was clear that their hope is to *catch up* with the industry's good record of achievement in meeting the problems in technology.

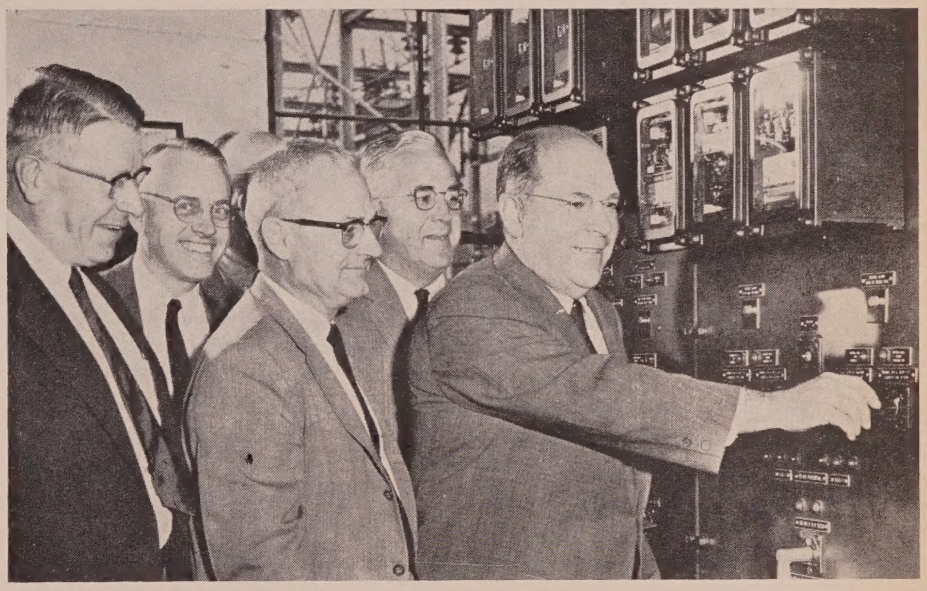
If the industrial revolution of the past century changed our management techniques so much, what changes shall there be in the next ten years, the first decade of the space age? Posing this question, Wm. Ismay, industrial relations manager of the Arizona P. S. Co., stressed in his survey of "the future composition of management," this aim of keeping pace with the technical end of the utility business. He asked: Are we giving anything near the emphasis to research into the skills of management as we are to the technological end of the business?

Mr. Ismay set the stage for workshop discussions by listing these further questions pertaining to the future composition of management.

1. What are we doing today to equip our managers to handle the complex problems of present day business and the more complex problems of the rapidly growing industrial community of tomorrow?
2. Does "budgetary near-sightedness" and "lockjaw of the pocket book" hobble every effort to expose managers to effective training in facets of the business other than their own?
3. Are we "inbred" in our ideas on management, afraid to mingle with the practitioners in other industries who have gone farther faster than we?
4. Have we considered the effects new tools have on management, such as the telescoping effect of organizational structures, due to rapidly and more comprehensive reporting?
5. What have we done in the "procreation" of management personnel in our individual companies? How many companies have given more than lip service to the positive selection and training of managers to replace those who will retire or leave the company by ordinary attrition in the next ten years?

Paul V. Hayden, vice-president public and employee relations, The Connecticut Light & Power Co., made this plea: "Let us do the kind of a job in the employee relations field that we, as an industry, have done in the physical supply of power to the country. We have never been too late with too little. Let's not win the big battle and then lose the war by default in the

(Continued on page 65)



World's highest voltage electric line, extending 13-miles in Central Pennsylvania, was energized recently in ceremony at Penelec's Claysburg substation. Turning switch on remote control panel is GPU's Pres. A. F. Tegen. With him (l. to r.) are: GPU V-P Ed. W. Morehouse, Penelec's Pres. L. H. Roddis, Jr., Transmission Supt. P. L. Lumnitzer and Eng. V-P R. F. Bovier.

Manufacturers Team Up,

GPU's Penelec Has First 460-kv Line

The highest pressure ever utilized in an electrical network in the United States is a key part of the record performance of the nation's first 460,000-volt network line—now operating over a stretch of 13-miles in central Pennsylvania. On September 30 the pioneer transmission line, which matches the voltage of any line operating anywhere in the world, was energized officially.

In placing this line in operation A. F. Tegen, president of the General Public Utilities Corporation, told industrial and civic leaders that this "Power Line of Tomorrow," came into being because of the imagination and progressive attitude of an investor-owned power company and investor-owned manufacturers of equipment. Mr. Tegen thanked the manufacturers for their contribution to "this milestone of progress."

Preliminary operation indicates

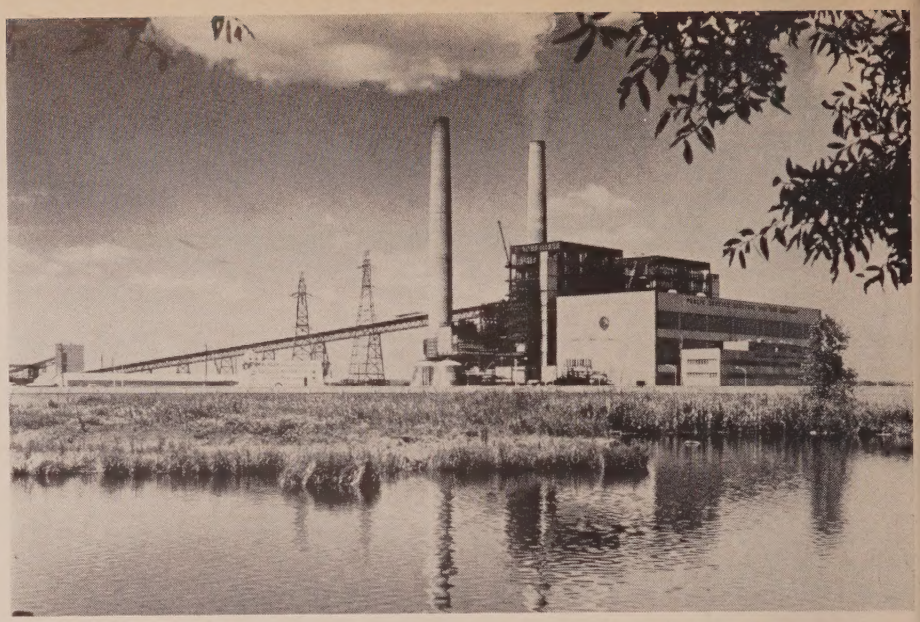
that pressures as high as 505,000-volts can be safely carried on the line which has wires as thick as a man's wrist, held up by porcelain insulators 15-feet long suspended from a variety of wood and steel structures towering 130 ft high.

"Not only was it necessary to create new electrical hardware, but entirely new construction methods had to be developed," Tegen said in praising Louis H. Roddis, Jr., president of Pennsylvania Electric Company (a GPU subsidiary) and his associates for completing the line in 260 days. The precedent-setting extra high voltage line parallels two of the 115,000-volt lines in this bi-state network.

The close proximity and capacity of these two existing lines were factors in selecting Saxton and Claysburg as terminals for the 460,-000-volt line, for they permit it to be operated as part of an integrated network under three-phase conditions. The line passes over two mountains and intervening valleys. Several other experimental lines have been built or are being built to operate at this same voltage but all have operated single phase without load.

"As important as the operation of this line is to the electrical industry and to everyone who uses electricity, it gives promise of being even more vital to the future economy of Pennsylvania," Mr. Roddis said in explaining why Penelec pioneered its construction. "The economy of Pennsylvania, especially that in the central part of the state, is heavily dependent on coal, whose future in turn is largely dependent upon the electrical industry. Nearly one-half of the nation's soft coal production is burned in generating stations and this proportion can be increased tremendously if coal's energy in the form of electricity can be carried in supersize amounts to all parts of the eastern seaboard."

There is an east-west exchange of power now over an interconnection maintained by utilities in Pennsylvania, New Jersey and Maryland which, despite capacity limitations has proven valuable, especially in times of equipment outages and of unexpected heavy demands. However, plans to move larger blocks of power as firm capacity for the growing power market have run into the problem of rights-of-way, especially in and near larger cities. A 460,000-volt line will provide relief here as it is capable of carrying 16 times as much electricity as a similar line operating at 115,000-volts since capacity increases in direct proportion to the square of the voltage. Thus, one EHV line requires a lot less real estate and is cheaper to build than 16 lines operating at 115,000 volts, Penelec notes.



Adding 580,000-kw with two generating units in its newest station, P. S. Elect. & Gas now has a total capacity over 3-million kw. Bergen Station was built at cost of $110-million. Public Service started this year with $267-million budgeted for further expansion.

But even with these savings, 460-kv lines would not be feasible unless a concentrated market can be found for large blocks of power and unless this power can be generated in one location at economical rates. GPU's rapidly growing subsidiaries in New Jersey have the customers for the power which its Pennsylvania subsidiaries can generate in the coal fields. Penelec's Shawville Station, recently expanded to the largest in the state with a net capacity of 615,000-kilowatts, is the type plant capable of serving an EHV line and of stimulating local economy. Its annual consumption of 1,800,000-tons of coal provides the main source of male employment in Clearfield County.

These factors, along with a long-time record of pioneering such innovations as pulverized-coal boilers, outdoor metering and long-span construction, led the GPU System to build the nation's first 460-kv line. Added was a desire to make a substantial contribution to the technology of the transmission art, a desire in which it was ably supported by the following manufacturers: General Electric Company, Ohio Brass Company, Aluminum Company of America, Kaiser Aluminum and Chemical Corporation, Pennsylvania Transformer Division of McGraw-Edison Company, I-T-E Circuit Breaker Company, Preformed Line Products Company, Union Metal Manufacturing Company, Rilco Laminated Products, Inc., Hughes Brothers, Inc., Bethlehem Steel Company and Copperweld Steel Company. Construction was shared by the Sordoni Construction Company and Day & Zimmerman, Inc.

The concerns not only assisted with pre-construction research and testing, but several will cooperate in the two-year testing program Penelec plans to conduct. Two mobile laboratories will be utilized to test operating characteristics and evaluate the relative advantages of the four different types of conductor and the 14 different types of structures used in construction.

In thanking the 14 cooperating companies for their assistance, Tegen indicated that GPU is already planning to extend the 460,-000-volt line as a logical step in its pioneering efforts of building "Kilowatt Turnpikes" from Lake Erie to the Atlantic Ocean—first at 115,000-volts and later at 230,000-volts.

Ind. Relations—*cont. from p. 63*

arena of public relations."

He said further: "I do not believe that a continuing program of motivating our employees to act as ambassadors of good will is formidable or costly. Certainly our various safety programs haven't proved to be. They are based primarily on a continuous repetition of a central theme, in different ways, day after day, month in and month out. The prime ingredient needed is the will to jump in and get the job started."

To make sure that conferees would be inspired to "push practical possibilities and not pause for perfection," as ConEdison's John C. Arnell put it, that utility's industrial relations director organized the conference approach to the all-important area of "manpower costs." He summarized it this way:

"With the vast amounts of new capital that this industry will require in the decades ahead, the competition for new money will continue to be vigorous and the need for maintaining earnings equally rigorous. We dare not, in the negotiation of our working agreements, or in the administration of them on a day-to-day basis, weaken our right to expect a fair day's work for a fair day's pay, our right to set new work standards which are realistic, our right to change working methods or job duties, our right to promote the most capable and our right to subcontract work.

"More effective manpower utilization is being accomplished through improved work methods, reorganization, mechanization and automation as needs are indicated. Cost conscious companies are planning more training for management and supervisory employees. Employees are being motivated to do a better job through accelerated training, communications and even encouragement to train themselves.

"We must keep our costs of operation under control by the constant application of intelligence, understanding and teamwork. We don't have to be 'Simon Legrees' but we *can* continuously seek to devise methods by which our work can be done more efficiently with less waste of time and effort."

Mr. Arnell reported that a sampling of utility company costs showed that 11¢ of the manpower dollar goes for items that don't even show up on the payroll, and an additional 10¢ of the payroll is spent for agreed-upon non-productive time such as vacations, holidays, sick absence and excused time, so that 21¢ of every manpower dollar is not even connected with production. He noted that the other 79¢ of the payroll cost is further diluted by hidden costs such as "coffee breaks," rest periods, excessive socializing, grievance discussions, etc.

Mr. Arnell observed that, while no common valid manpower cost or productivity index has been developed that is generally accepted in our industry, just the simple attempt to measure human performance seems to improve it.

And, he added this caution: "Never forget that back of all these yardsticks lie management philosophies, operating methods, ideas and people. What is the yardstick for a story of teamwork and effort?"

Fred R. Rauch, vice-president of The Cincinnati Gas & Electric Co., was asked by the conference chairman to raise questions and problems in which union-management relationships with the utility companies will be concerned in the years ahead. He said these might be divided into three general categories: (1) problems of protection; (2) problems of adjustment and prevention; and, (3) problems of opportunity. He discussed their scope as follows:

"The problems of protection will include the protection of management's freedom to manage; the protection of the union's freedom to protest; the protection of employees against unemployement induced by technology; the protection of profit margins; and, the protection against unbalanced power which threatens the survival of either management or labor.

"The problems of adjustment and prevention will result primarily from the negotiation of new agreements; the prevention of disputes; and, the methods used in the settlement of grievances arising under existing agreements.

"Problems of opportunity will result from employee-sought opportunities to exercise initiative, judgment, skill and other qualities that are regarded as desirable; from employee-sought opportunities for greater job satisfaction, increased leisure time, and individual recognition."

Mr. Rauch expressed doubt that all such problems will ever be solved, "for as rapidly as we solve one, such others are being created not only by technological and organizational changes which alter the nature of working conditions, but also by changes in our ideas of what is worth while."

Mr. Rauch suggested that particular consideration be given to this question: "How will we preserve management's freedom to perform the functions of management under labor contracts negotiated in the years ahead?"

The real problem—of determining what decisions should be made unilaterally by management—is a crucial one, he said, "for on its solution depends the whole nature of union management relationships in the years ahead."

YARDSTICKS FOR MEASURING UTILITY MANPOWER COSTS

	High	Low	Average
MANPOWER COSTS			
% of Operating Revenue	34.5	21.0	26.3
CUSTOMERS			
Per Employee	191.4	98.9	131.0
REVENUE			
Per Employee	$33,591	$19,345	$26,690
KWH SOLD (1,000's)			
Per Employee	2,399	752	1,306

Data from 63 utility companies on yardsticks used to measure manpower costs show a wide variation. A small company had the lowest ratio of 21-percent of operation revenue and a medium large company had the highest ratio. A medium large company had the low of 98.9-customers and a small company had the high of 191.4. There is an "amazing" spread in kwh, but this gap is closed when revenue dollars are considered, the EEI industrial relations committee notes. The yardstick most frequently used is the ratio to revenue, with the number of customers per employee and revenue-per-employee next.

Mt. Sheep "Superior," FPC Staff Testifies

Testimony was in and last week the FPC began the task of cross-examining witnesses in an affort to resolve the controversy over what is the best way to develop the resources of the Snake River–High Mountain Sheep or Nez Perce.

Pacific Northwest Power Co., which has long sought to build the proposed 690-ft high Mountain Sheep project, drew new encouragement last month, when FPC's technical staff added its findings to the record: Development of the power and flood control resources of the Middle Snake River with the multi-purpose High Mountain Sheep project is found to be superior to the alternate Nez Perce plan. The staff report places the Technical Group of the Commission in agreement with the engineering studies and conclusions of the Power Company.

The FPC staff studies were based on several parallel basic assumptions as to project starting time and interest rates of money, and show more power is developed, greater flood control benefits are obtained and substantially better net annual benefits favoring the High Mountain Plan of Development.

On the assumption that the alternative plans could be completed in 1967, the FPC staff said the High Mountain Sheep Plan would have a power advantage over the Nez Perce Plan of 177,999-kilowatts of prime power. At an interest rate of 4½-percent, the net annual costs of High Mountain Sheep Plan would be $609,000 less-costly than Nez Perce, the FPC staff said.

On the assumption that High Mountain Sheep could be in service in 1967, but that Nez Perce or Lower Canyon were delayed an additional ten years to 1977, the agency's staff found that at 4½-percent interest rate, the advantage for High Mountain Sheep would average $11,211,000 every year over a 60-year period.

In economic feasibility studies, the FPC gave High Mountain Sheep a benefit-to-cost ratio of 1.47-to-1 against a maximum of 1.35-to-1 for Nez Perce. The staff generally approved the designs for both projects, finding each competent and safe.

Cost estimates submitted earlier by both applicants received general acceptance by the agency staff, which adjust High Mountain Sheep to cost of $190,662,000 and put a figure of $425,914,999 on Nez Perce.

Last month a PNP spokesman labeled "unrealistic" the cost estimate of 2.85-mills-per-kwh for power from Nez Perce during its first year. In turn, Armor B. Martin, engineer and management coordinator for PNP, said that power from the High Mountain Sheep Dam on the Snake River will be delivered at a price one mill per kilowatt lower than power from the conflicting Nez Perce project proposed by public utility districts of Washington State.

The PNP engineer insisted the public is being "deliberately misled" by the PUD sponsors of Nez Perce. He said the PUD claims are based on isolated and single-project operation of Nez Perce.

"Considering all of the proper factors to arrive at the true power costs," Mr. Martin said, "Nez Perce power delivered to load centers will be 4.95-mills-per-killowatt hour at wholesale as compared to only 3.90-mills-for-power from the company's High Mountain Sheep project.

Cost of High Mountain Sheep will be $257,100,000 for a $252 cost per kilowatt of generating capacity. The cost of Nez Perce will be $611,000,000 and per kilowatt capacity cost of $434, according to Mr. Martin.

PG&E's Geothermal Plant Is "Triumph of Vision"

America's first electric power plant operated by natural steam from geysers is now in regular service.

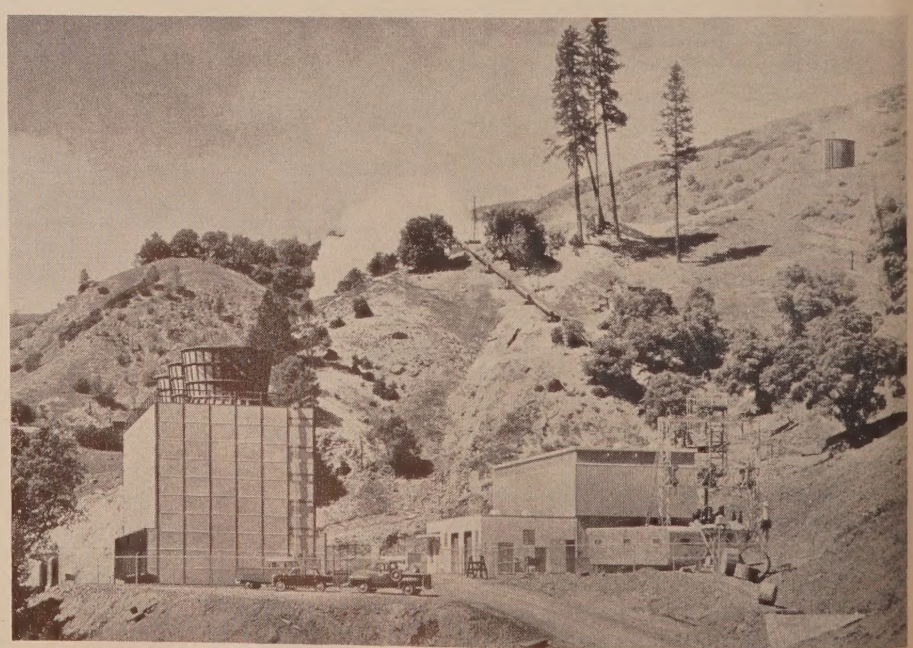
Pacific Gas and Electric Company on September 30 dedicated this country's pioneer commercial geothermal generating station. It is a 12,500-kilowatt powerhouse at The Geysers in Northeastern Snoma County, California, about 100 miles from San Francisco. Its turbine generator is driven by steam from wells drilled into the volcanic formations near the earth's surface in that area.

The Geysers Power Plant, as it is officially named, uses about 240,000-pounds of steam per hour, which reaches the well heads from within the earth at a pressure of 115-pounds per square inch and strikes the turbine at 100-pounds. Its temperature is around 350 degrees F.

In the dedication address PG&E Pres. Norman R. Sutherland said:

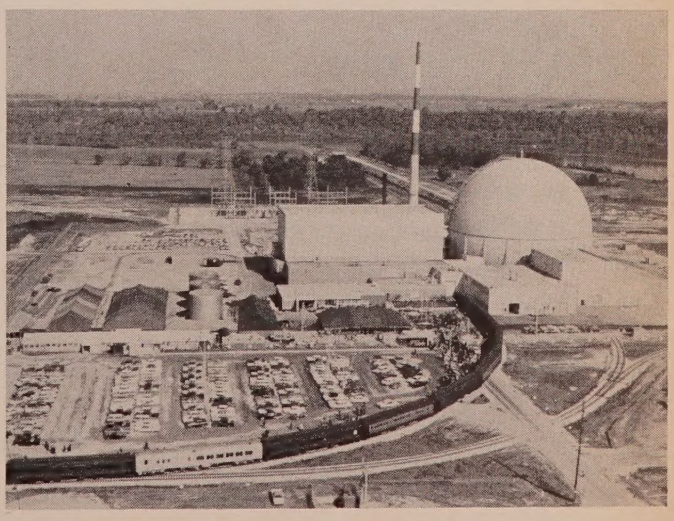
"This unique plant–small but very significant–is a triumph of vision and determination. The enterprising men who kept coming here over the years determined that the natural heat energy could be put to work. They kept at it until they proved they were right."

The present development began in 1955 and the first large well was drilled by the Magma Power Co.



From well area (at top center) in PG&E's newly completed geothermal project, steam reaches 12,500-kw turbine-generator in building at right through a quarter-mile long pipeline.

Gathered in Dresden's control room after dedication ceremony, chief executives of member companies of the Nuclear Power Group are (l to r): Illinois Power's Allen Van Wyck, Union Electric's J. W. McAfee, K. C. P. & L. Co.'s Robt. A. Olson, Central Illinois Light Co.'s E. D. Edwards, Bechtel's S. D. Bechtel, AEP Service Corp.'s Philip Sporn and PG&E's N. R. Sutherland. Before them: GE's Cordiner, AEC Chairman John A. McCone, Commonwealth Edison's Willis Gale.

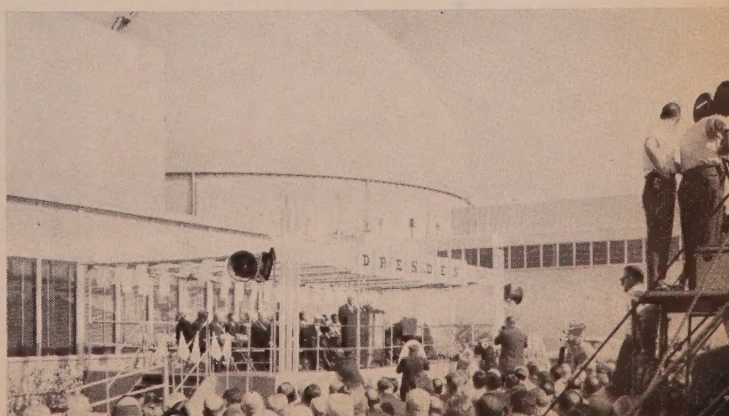


Private Enterprise Meets A Challenge: "Dresden Passes Tests, Colors Flying"

Dresden had its big day last month—a dedication day that was a mighty big one for many men and their organizations, all responsible in some important way for this very demonstrable success story of American free enterprise.

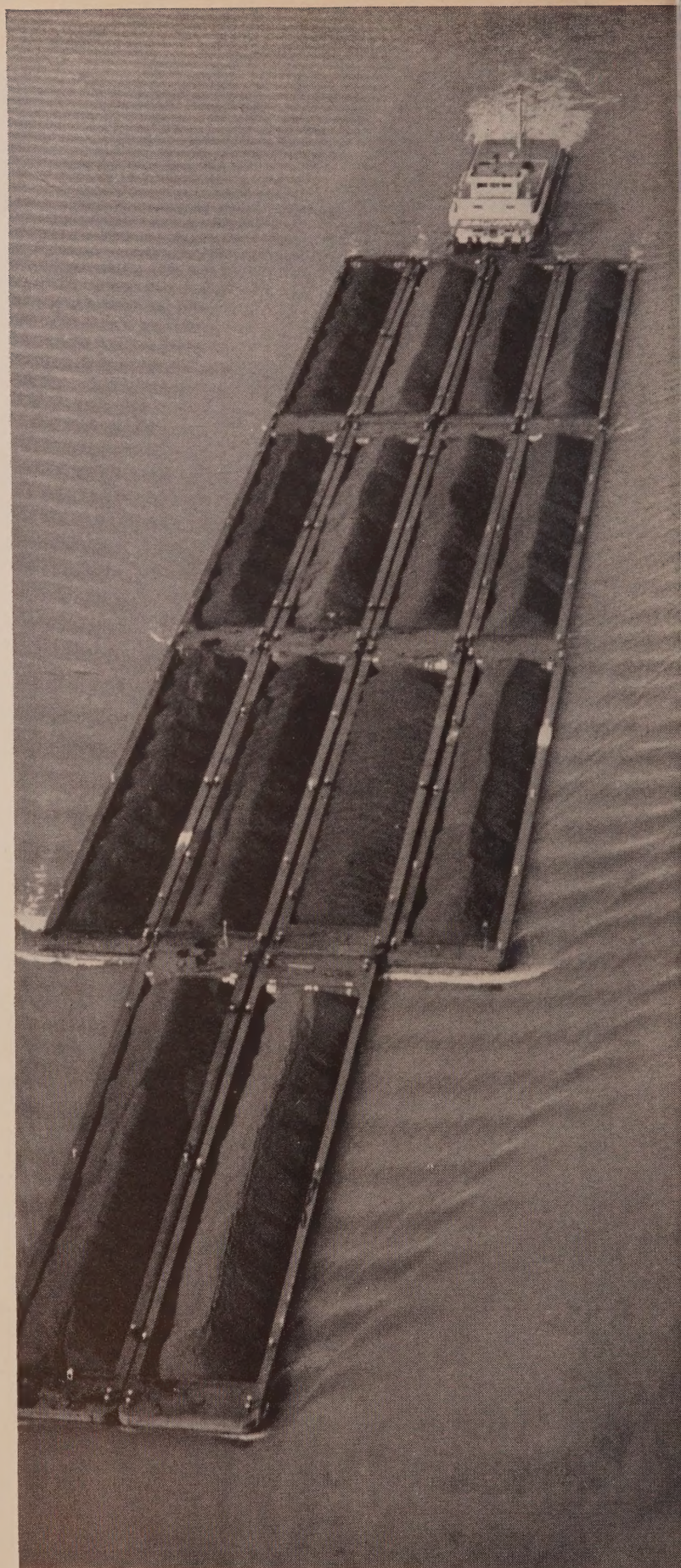
GE's Chairman Cordiner called it "business leadership of the highest order"—the investment of millions of dollars in a bold plan to prove a point: the conviction held by Willis Gale, Commonwealth Edison's Chairman, that "private enterprise had to respond to the challenge of nuclear power—not with paper studies and political propaganda, but with a direct commitment to build a full-scale, operating atomic power station."

Now, in October, 1960—ahead of schedule, Mr. Cordiner declared: "Mr. Gale, the Dresden Station has passed its tests with flying colors . . ."



how does 1970 look... from here?

(and how about 1980?)



The most look-ahead industry in the nation is undoubtedly the electric utilities. Glance back over the past 10 years and the reason is obvious. And with even greater electric needs forecast for the next 10 and 20 years, it's not surprising that any remaining short-term thinking about the way to buy *coal* is giving way rapidly to the same *long look ahead.*

There is increasing awareness that behind an attractive invoice price can be the hidden incremental costs of excessive coal handling, ash handling, equipment outages, freight charges on inerts, operating inefficiencies of many kinds.

There is increasing interest in quality coal that delivers *steam* at the lowest *net* cost. There is increasing interest in adequate reserves, in uniformity of supply, in suppliers in a position to deliver the right kind of coal on a reassuring long-term contract basis.

An increasing number of utilities are looking to Island Creek as a supplier of such coal . . . and such reassurance. We'd welcome a chance to discuss this matter more specifically with you. Write, wire or phone.

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Water Resources: "Open Door" to New Analysis?

Strengthened government policies affecting water development and use—along with new emphasis on the need for a more comprehensive development program, plus more scientific research—are certain to be the core of recommendations that will come from the U.S. Senate Select Committee on National Water Resources. The Committee's final report on a long-term national program based on studies called for by Senate Resolution 48 is expected to be made later this year, before Congress reconvenes in January.

Clues to what this Committee will have in its balance sheet and resultant plans for remedial action have come from a number of public disclosures by Committee members and staff, particularly. Especially revealing was a presentation made late this summer to the Western Resources Conference held in Boulder, Colorado, by the Committee's staff director, Theodore M. Schad. Although Mr. Schad pointed out that his remarks should not be construed as reflecting the views of the Senate Committee, the nature of the Committee's findings is unavoidably indicated in his presentation.

"The Committee's efforts have merely opened the door to a new type of anaylsis of water resources," he cautioned. "In order to take advantage of and build on what has been done, two other types of study are believed to be necessary." Mr. Schad identified these as (1) one or two temporary commissions to deal with emerging water problems in areas where water shortages will be most acute by 1980 (the arid states of the Southwest, the industrialized areas of the Northeast); and (2) a periodic assessment by the Federal government of the water supply-demand outlook for each of the water resources regions of the U.S.

The Committee divided the country into 22 water resource regions, based on river basins or groups of river basins having similar characteristics (though conditions throughout a region may not be uniform). The Committee also developed a new concept for expressing water demands—water losses plus flow requirements—and Mr. Schad expressed the hope that its use would minimize misunderstandings which have sometimes arisen when water needs are sometimes expressed as gross withdrawals.

Projecting present trends into the future (without considering the expected establishment of water use priorities and automatic curtailment of low priority uses), the Committee anticipates water shortages in nine of the 11 Western regions by the year 2000. Mr. Schad expressed the view that these shortages of water will *not* actually control development of the basins, however.

Policies that will help in meeting the water and water-related needs of the nation have been the subject of almost continuous study and discussion for many years, observed Mr. Schad. The policy changes which are necessary are difficult to determine, he said, and they will evolve slowly . . as the needs become obvious.

According to the Committee's staff director, these steps appear to hold the most promise at this time: (1) Preparing long-range comprehensive plans for water development and management programs, basin by basin; (2) providing for a continuing appraisal of the situation so that necessary action to meet emerging water problems can be taken in advance of actual needs; (3) providing maximum flexibility to local, State, and Federal agencies in dealing with water problems as they arise; (4) obtaining the facts upon which improvements in technologies for use of available water and additions to presently known supplies can be based; (5) broadening the use of water saving technologies already available; and (6) strengthening Federal policies for dealing with water resources.

Mr. Schad emphasized these considerations in detailing the conditions and related proposals covered by the Committee's deliberations:

1. The concept of comprehensive development should be redefined to include all purposes served by water resources and all measures available for meeting prospective demands (instead of the usual limitation to management of surface water resources as in the past).

2. Because water problems are and will continue to be local or regional rather than national in nature, the importance of state and local planning and decision making is stressed. And, to avoid some of the problems of inadequate state planning, Federal support could be provided to the states on a matching basis. (If cooperative endeavors are to be fostered, more flexibility in Federal budgetary procedures will be needed.)

3. A careful inventory of existing Federal research programs in water and the development of a coordinated program for future accomplishment is essential. A great deal more research (particularly "basic") and a demonstration of these processes is needed. (Area most urgently in need of attention: treatment of sewage and industrial wastes.)

4. In spite of the existence of many inconsistencies in present Federal water resource policies, and the unlikelihood that any significant changes will be made in the realignment of either Congressional

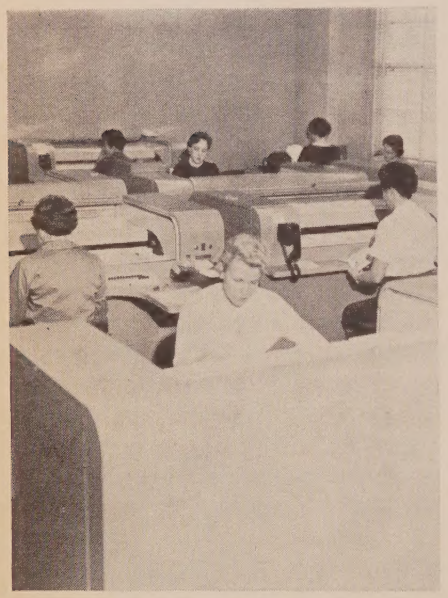
(Continued on page 101)

MECHANIZATION SPEEDS CUSTOMER SERVICE

Combination of punched-card processing and push-button files solves customer service and index records problems. Complete facts on any account are brought to operator's fingertips in a matter of seconds.

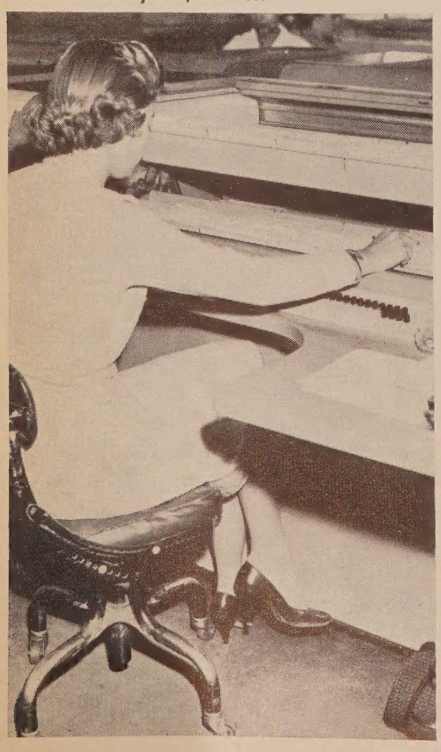
By ALLEN B. WILSON

Assistant Treasurer
Georgia Power Company



All customer service and history (index) records, converted into punched-card form and housed in desk-sized mechanically operated units, help Georgia Power maintain high standard of customer service.

Complete facts on any customer account are brought to operator's fingertips in a few seconds. It is estimated that system will pay for itself in three years, or less.



A NEW mechanized system of record keeping has materially helped Georgia Power Company to maintain the high standard of customer service that has been its lifelong tradition.

Although the system has not yet been priced out, it is conservatively estimated that it will pay for itself in three years, or less. Some of its benefits are: less floor space, personnel reductions, better working conditions, considerably less operator fatigue, better morale, pride of station tenancy, flexibility of expansion, mechanization of record replacement, coordination of record maintenance, ease of reference, etc.

Fast Access Important

Few problems in today's electric utility office are more important than the need for fast access to customer service and index records. Any time, the office is apt to be swamped with inquiries concerning specific accounts—some made by customer name and some by customer address—and the ability to handle these calls promptly is a significant measure of customer service.

Georgia Power's territory covers practically the entire state and includes the city of Atlanta. We serve 820,000 meters representing 701,000 electric power customers, throughout a territory of about 58,000 sq. mi. There are 110 commercial offices within the area, ranging in size from Atlanta, which serves 250,000 customers, to some offices serving less than 1,000. Late in 1958, after years of steadily increasing business volume, we decided it was time for a change from our conventional manual record keeping method.

Two-Fold Plan

Our plan for streamlining the system was two-fold. First, we decided to convert the customer service and history (index) records into punched-card form—records that could be reproduced, prepared, sorted and replaced mechanically, and that would provide for re-entry upon the installation of a tape system.

Secondly, we decided to house these records in Remington Rand Kard-Veyer units. These are desk-size mechanically operated units that work on the principle of the

conveyor belt. The operator sits in one place, and at the touch of a control button the file of cards revolves inside the desk until the desired records are brought to her fingertips.

Obviously, a difficult record conversion problem had to be solved. A policy decision assisted materially. Management approved the transposition of the surname in the address card. Now, customer names are shown on the bills and accounting records with the surname first—the same as listed in the telephone directory. This permitted mechanized sorting, as will be seen later.

Records Reduced

Previously, there were three records housed in the two files involved. The customer service file contained a master location record, filed in visible record pockets in street and house number sequence, on which was recorded the customer name and meter data. A multiple use meter order was filed in the same pocket with the corresponding master location record. The customer history file contained the service applications filed in customer name sequence. Complete cross-reference was provided—by customer name or address.

It was decided that these three records could be reduced to two records and still provide the desired information and results. Thereupon, an index card was designed that would fulfill the requirements of the history record as well as serve as a meter order.

Then a street location card was designed to satisfy the needs otherwise for a service location record. So, in effect, the meter order was removed from the customer service location file, arranged in name sequence, and a consolidation of the meter order and the former history record thereby realized.

New Records Created

The address cards and the meter reading (billing) cards contained all the information necessary to create the new index and service location records. Consequently, it was possible to develop highly mechanized procedures to create, and sort into the desired sequence, the new records.

It was necessary to key punch customer names only, showing surnames first, into reproduced address cards. Following this the entire operation was almost completely mechanized.

Index cards were created first—being reproduced from the address cards. Then, meter and rate data were posted mechanically from the billing cards onto the index cards. Next, the index cards were mechanically sorted into name sequence.

Advanced Filing Installed

No longer does it hold that advanced filing equipment cannot be installed because of prohibitive record conversion costs. For example, the index cards for the Atlanta accounts—a quarter million—were created within a 30-day period. In one week-end, these 250,000 records were fine sorted mechanically into name sequence, listed for visual review, and the lists checked visually for accuracy of sorting. Cost of sorting: $4 per thousand.

In a subsequent 30-day period, the street location cards for the Atlanta accounts were created—all 250,000 of them. No key punching was required for this record. It is possible to code the cards mechanically as to the number of digits in the house number and the card column in which the street name starts. With this code, the street number and street name can be shifted through selection into standardized card columns in the card into which reproduced.

The street location card was also reproduced from the address card, punching street number, street name, town and account number. The current customer's name and meter data were then mechanically posted to the street location card. Sorting of this record to street and house number sequence was much easier than the index card sort. But again, economy of record conversion facilitated justification of file replacement considerably.

Cards Were Created

And so it went for 10 months during 1959. Index cards and street location cards were created for workable segments of the accounts in volumes of 200 to 250 thousand at a time, skipping a month now and then for a breather. As of November 1959, 820,000 index cards and 500,000 street location cards (for larger offices only) had been created.

A total of 1,325,000 records were created and sorted into file sequence. The Atlanta installation, being the largest, was the most difficult. However, the old records were moved out on a Friday night, and the mechanically operated units were in operation the next Monday morning.

Large Filing Capacity

A very distinct advantage offered by these units is the large filing capacity of a unit. In this particular application it is not practical to load the files to maximum capacity. However, the spare space permits file volume variation to compensate for work load inequities. In this manner operator assignments can be equalized by adjusting the volume of records per cabinet (station).

In the Atlanta office, the 250,000 index records are housed in four Kard-Veyers, varying from 60 to 70 thousand records per unit. Because of greater activity, the same number of street location records require five of these units. Self-indexing file guides, spaced approximately ½-in. apart, are used throughout—providing a visible file effect.

Utility accountants familiar with meter order systems readily realize that it would be impossible to explain the operation of this system within the limited confines of this article. Basically, service requests are processed first through the street location file and then through the index file. Eventual plans include the automatic transmission of meter orders to the operating department in the Atlanta area.

No Manual Corrections

An important feature of the system, though, is that manual corrections of the records are not permitted. As is too well known, a percentage of error will creep into any manually maintained file over a period of time, and it is prohibitively expensive to audit such a file. Therefore, when a correction is required, the incorrect record is replaced with a mechanically prepared record originated from the billing records (after those records have been corrected). In this manner, all records remain in agreement—the billing records with the file records, and conversely.

Penelec, Co-ops Unite On Hydro-Storage Plan

In an unprecedented joint venture designed to develop the maximum power potential of the proposed Kinzua Dam near Warren, Pa. and at the same time to utilize Pennsylvania coal to a greater extent in generating electricity, the Pennsylvania Electric Company and the Warren Electric Cooperative, Inc., have discussed with the Federal Power Commission applications for permits to study the power potential of the dam being built on the Allegheny River by the U. S. Army Corps of Engineers.

Heads of the participating organizations termed the proposal one which will unite investor-owned and federally-financed electrical companies in a common project which may well be an example for future development of similar projects throughout the country.

The two separate applications ask permission "to secure and maintain priority for a license under the Federal Power Act while procuring data and performing the acts necessary to perfect an application for such a license." Studied will be the feasibility of these two projects:

1. By the Warren Electric Cooperative to construct a hydro electric generating plant of approximately 17,500 kilowatts capacity using "run-of-river" flow; a possible re-regulating dam two and one-half miles downstream that could increase the output to 30/75,000 kilowatts; and a pump-back arrangement that would yield 50/125,000 kilowatts.
2. By Pennsylvania Electric Company to construct a facility which would use coal-produced electricity during off-peak periods to pump water from the Allegheny River Reservoir to a reservoir on top of a nearby hill. The water would be released during on-peak periods to operate hydro generators. Capacity will be between 75,000 and 300,000 kilowatts.

Both projects would be operated by Penelec and the power generated would be transmitted over its 17,000-miles of lines, and Penelec would deliver power from the projects to the thirteen cooperatives which are supporting the applications.

"Essentially, what we propose to do is build a large energy battery," Mr. Roddis said in explaining Penelec's proposal. "Electricity generated in our coal-burning plants during off-peak periods would be used to pump water from the Allegheny Reservoir to our impounding pond at a higher elevation. During periods of peak demand, the water would flow down hill, back into the reservoir, generating electricity in the process. Thus, the river water would only be borrowed to store energy in a manner analogous to the common storage battery."
Power System.

New $7.5-million Breed Generating Plant of Indiana & Michigan Elect. Co., containing world's largest single generating unit, is seen from Illinois side of the Wabash River. Power produced by 475-megawatt unit is carried from plant over a 186-mile, 345,000-volt transmission line.

Sporn: New Breed Plant Signals Progress Ahead

"The Breed project, all that has preceded it, all that is now planned for future expansion, demonstrate not only that this can be done but that in this dynamic area of the United States—in Indiana and in the portions of the six other states served by the AEP System—it has been done," declared Philip Sporn, president of Indiana & Michigan Electric Co. and American Electric

Speaking at the dedicatory ceremonies of the huge generating station, largest and most efficient generating station in the world, he went on to point out that "Progress in advanced power generation technology on the AEP System will not stop with Breed. Already we are at work planning new units and designing new plants, to be built to meet the requirements of our area and of our communities for additional electric power so that they can continue to grow, develop, and prosper.

"The new units will probably be bigger in size. But whether bigger or not, we *are* confident of one thing: they will be better generating units and better plants, and they in turn will establish new milestones along the road of progress in the production of electric power."

The new unit raises I&M's total generating capability to more than 1450-mw, an increase of about one-third. It also boosts the entire AEP system capacity above the 6-million-kw level, making it the first private utility system to achieve this.

Although the Breed Plant unit was designed for a capacity of 450 mw, it has already demonstrated a capability of 480-mw. Some minor engineering changes to be made would raise its capability to 500-mw.

EHV Cable Project Opened At Cornell

The materialization of the first electrical testing station for extra-high-voltage underground cable which was conceived, developed and built by private enterprise, was witnessed on September 14, 1960 at Cornell University, Ithaca, New York. (See pages 51-52—July 1, 1960 Electric Light and Power.)

This station was designed and constructed to conduct tests in the field under service-loading conditions on underground cable systems designed for 345-kv operation. The combined manufacturer-user cost of this project is approximately $3,000,000.

The opening of this station sees the culmination of Phase 1 of this project, which was conceived in 1953. The upsurge in overhead transmission voltages and station machine capacity at that time made it necessary that underground cable systems be developed that could satisfactorily operate and carry loads of 500 mva or more.

This project was of mutual interest to both manufacturer and user. Therefore, a cooperative project was agreed upon between the electric utilities, represented by the Association of Edison Illuminating Companies and the Edison Electric Institute; four cable manufacturers, namely, Anaconda Wire and Cable Co., General Cable Corp., Phelps Dodge Copper Products Corp. and The Okonite Co.; two terminal manufacturers, G & W Electric Specialty Co. and Ohio Brass Co., and one pressurizing equipment manufacturer, Jerome Hydraulics Co. New York State Electric & Gas Corp. is the service utility.

Cornell University was selected for the test site on the basis of providing a research project in the power field that could be participated in by faculty and student body. With its national student body coverage it provides an excellent location for acquainting students with research problems in the utility power field.

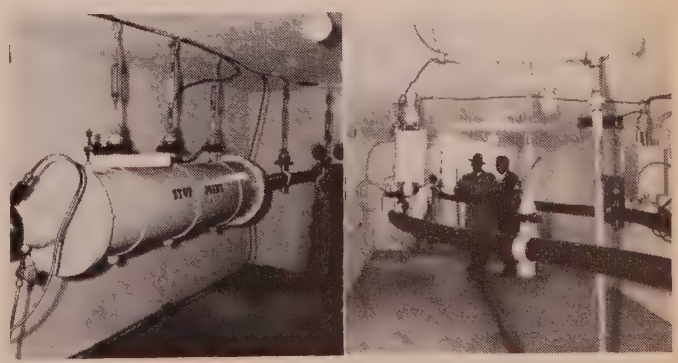
Subsequent to 1953 the manufacturers developed cable and accessories through research and testing in their laboratories and the utilities and their associations provided for the construction of the test site. Numerous other companies provided equipment and material for the construction and operation of the station.

In order to include a number of experience-proven systems the following types have been developed and supplied by the four cable manufacturers: Anaconda Wire and Cable Co.: low-pressure lead-sheath self-contained oil-filled cable; General Cable Corp.: high-pressure oil pipe-type cable; Phelps Dodge Copper Products Corp.: high-pressure aluminum-sheathed self-contained oil-filled cable; The Okonite Co.: high-pressure oil pipe-type cable.

The second phase of the project will probably require a period of three years which involves energizing the systems. During the first two years the voltage will be raised in gradual steps from 345 kv, with loading temperatures comparable to commercial operating conditions. Following the two-year period will be tests at elevated temperatures and voltages up to 500 kv, so as to further determine the characteristics of the systems.

The energizing of this testing station marks a significant step in cooperation among manufacturer, user and university in the organization, construction and operation of a basic research enterprise.

EHV Cable Testing Station at Cornell University—first of its kind—conceived, developed and built by private enterprise, is inspected by utilities, educators and manufacturers. It is designed and constructed to conduct tests in the field under service loading conditions on 345-kv underground cable systems.



Manhole view shows 345-kv cables, hangers, and stop joints. Note turnbuckle adjustments for cable leveling.

Making three-year groundline check to determine value of groundline treatment of standing pole. Rigid inspection of poles has materially contributed to elimination of pole failures.

DISTRIBUTION LINE MAINTENANCE PROGRAM PROVES EFFECTIVE

How VEPCo's comprehensive maintenance program has eliminated pole failures and materially reduced line outages.

By Robert L. Ware, Manager
Transmission & Distribution Department
Virginia Electric and Power Company

THE Virginia Electric and Power Company has set up a distribution line maintenance program that has proved extremely beneficial and effective over the past several years. It has produced an excellent record of eliminating pole failures and has materially reduced line outages.

Our service area covers 32,000 sq mi—a broad range of soil and climatic conditions from coastal areas, through the piedmont regions to the Blue Ridge mountains, the valley of Virginia, and into the Allegheny mountains. We have 124 distribution line crews dispersed over this area in 36 separate locations. Approximately half of these line crews are five-man crews, and half are eight-man crews. There are also 16 substation crews located at district headquarters.

All lines up to 50 kv are classed as distribution. We have approximately 635,000 poles, most of which are creosoted pine, supporting 28,750 miles of distribution circuits. These circuits supply 149,000 distribution transformers totaling 2,219,000 kva, and approximately 600,000 kvar of capacitors. We serve 735,000 customers in this area, and our peaks now occur in the summer. Our system peak in 1959 was 1617 mw net for one hour and a maximum load during the hour of 1636 mw.

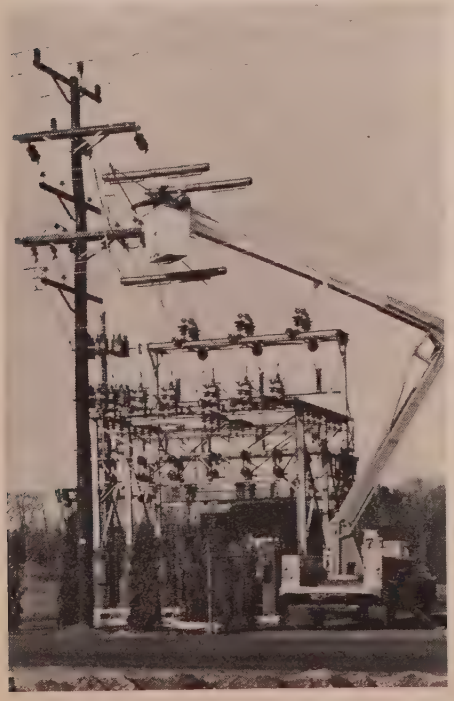
Wood Poles

When we first began to use creosoted pine poles, we purchased them under specifications for 10-lb per cu ft full-cell treatment. We changed our specifications in 1930 to an eight-lb per cu ft empty-cell

treatment in the belief that this would give proper pole protection. Over the 20 years following 1930, however, original-growth pine poles began to be replaced with second-growth timber with increased sapwood. This reduced the concentration of the creosote as it had to be spread over an increased volume of wood. This, coupled with the poor grades of creosote available to pole manufacturers during the war years, began to give us a much higher pole-failure rate than we had expected. In 1955, our specifications were changed to 10-lb final retention, and we are using some 12-lb retention poles on transmission circuits to gain experience with the number of bleeders we may expect if we decide to use 12-lb retention poles for distribution.

The immediate problem facing us was the methods available to increase the life expectancy of the many thousands of poles in service that had received an eight-lb treatment. The investment in a standing pole can be many times the cost of the treated timber, due to the increasing cost of labor involved in replacing the pole and transferring the conductors and appurtenances. We, therefore, felt that we should give serious consideration to methods for prolonging the life of standing poles.

Hydraulic lift is used by linemen to replace bolted connectors with compression connectors on energized lines. Elimination of bolted connectors have materially reduced line outages.



Homemade test set is used to teach foremen, linemen and servicemen importance of conductor cleaning, use of inhibitor, tool adjustment, and proper selection of dies. A. C. Brown, Jr., VEPCo's system supervisor of distribution methods is shown with test set.

Treatment Program

Our program for groundline treatment of standing poles, begun about three years ago, has varied from 18,000 to 30,000 poles per year. We believe that all poles which have been standing 15 years or more should be treated at the groundline. We have used the services of three pole treating companies. We do not know which type of treatment is best, nor do we know how long any of the treatments will be effective. We feel that the inspection of poles, a by-product of the groundline treatment, has been worth the treatment cost. The contractors who treat our poles do not treat poles which they consider unfit to receive treatment due to advanced decay. These defective poles are reported to us immediately, on a "replace within one year" or "danger—replace immediately" basis. We attribute our excellent record of eliminating pole failures to this inspection service.

We also discovered in our studies, that we were having premature failures of poles which had been removed from their original location and reset in a new location. We believe that many of these failures occurred when the pole was reset to a new location because the remaining creosote was not sufficient to keep fungi and rot from developing.

We remove from 8000 to 10,000 poles annually for reasons other than for maintenance and now have them returned to storage areas reserved for old poles.

The poles selected for immediate re-use, when installed, are marked with a dating nail, and a special nail which indicates that the soil has been sterilized. This is accomplished by pouring two gal of crystal-free creosote oil around the pole after it has been nearly completely tamped, and mixing some of the oil with the final back-fill. The poles selected for re-treatment are returned to a conveniently located creosoting plant.

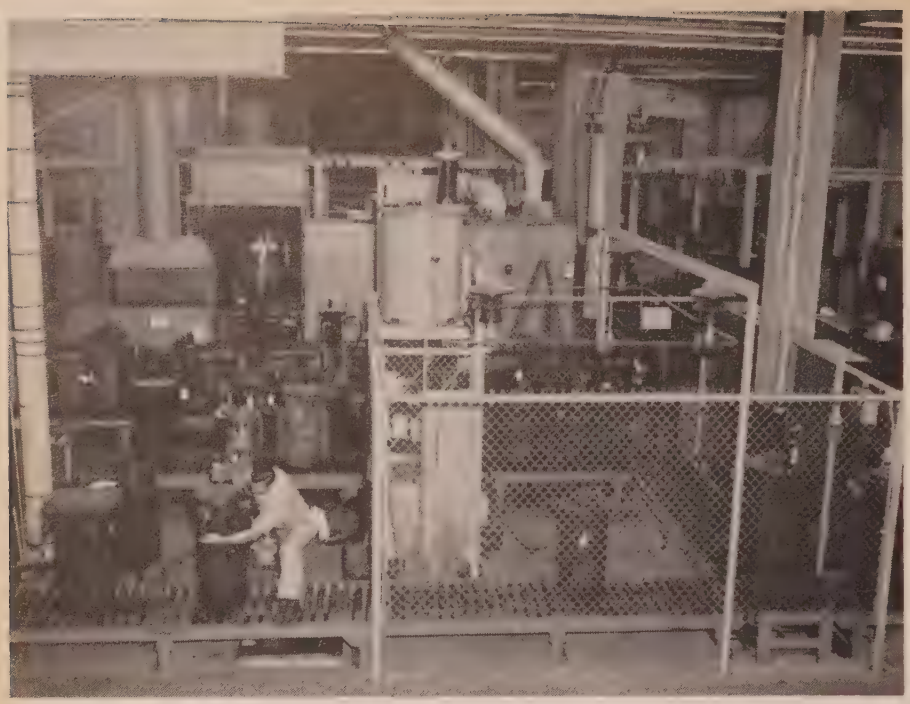
Conductors

In the mid-forties we began the widespread use of aluminum conductors on distribution circuits, and except in rare instances, we now only use copper conductors in our coastal areas close to the ocean or salt bays. During our first ten years' experience with aluminum, we used compression full-tension splices on conductors larger than #1/0 ACSR, and twist sleeves on smaller conductors, but most of the other connections were made with bolted connectors. The use of inhibitors was messy and when overtorqued bolts in connectors broke, the usual tendency was to undertorque the bolts.

In the latter part of 1956, and in 1957, we began to experience an unusually high rate of failures in connections, not only in aluminum to aluminum, and aluminum to copper, but also in copper to copper connections. When we examined many of these failures, we found serious evidences of internal arcing, burning, and large build-up of conductor oxides.

Compression Connectors

Because of these failures, we began a rather thorough study of



VEPCo handles complete maintenance and testing of all distribution transformers at the system shop. Oil is removed, core and coil inspected, repaired and flushed, the tank cleaned and painted, gaskets and bushings repaired, reassembled and filled with reclaimed inhibited oil.

Maintenance and salvage of overhead line materials is performed at the shops and stores building at Richmond.

compression connectors and tools available, and finally in the middle of 1958, we were completely tooled up with compression tools on our entire system.

In order to teach our foremen, linemen, and servicemen the importance of conductor cleaning, use of inhibitor, tool adjustment, and proper selection of dies, we built several test sets to show the temperature difference between a good and a poor connection. We used old 500:5-amp current transformers, energized on the secondary sides at 120 v through a variable transformer, and on the primary side connected loops of conductor with good and poor compression connections.

Then we began the actual replacement of all bolted connections on our sub-transmission circuits and heavy 15-kv feeders. Crews were divided into two-man teams and were supplied with 150-F Tempilstiks, a heat-graduated crayon, to test other bolted connections on the poles being reworked.

We also removed all hot line clamps directly attached to conductors by using stirrups affixed with compression connectors. We have limited the use of hot line clamps to transformer and arrester connections and recloser installations on small-conductor lines.

Line Outages Reduced

From records before and after our start in eliminating bolted connectors, we know that we have materially reduced line outages. After the main circuits are completely reworked, we feel that the problem will continue, to a lesser degree, until we have eliminated faulty connections. The many connections, particularly the aluminum service to copper customer entrance connections, continue to worry us.

We do not think that compression connections are the final answer to good connections. They are merely the best method at present, due chiefly to the fact that the compression connector is inhibitor-filled, and the tool, in good adjustment, makes a uniform compression.

Reclosers, Sectionalizers and Oil Switches

We have on our system approximately 4000 line type oil reclosers and sectionalizers, and small oil switches controlling switched capacitors, all of which are maintained in the substation shops of each of the 11 districts. The interval between maintenance inspections for reclosers is two years or 100 operations; for sectionalizers, two years; and for oil switches, six months. The device is removed and a replacement unit installed. The removed device is dismantled for inspection and replacement of damaged or worn parts, cleaned, new oil added, and reassembled. It is then subjected to 1.5 times rated voltage for one minute, and given an operation test, after which it becomes a stock replacement unit.

Distribution Transformers

Our Company maintains a system shop which handles the repair and repainting of all distribution transformers. Any transformer which has been in service 10 years, or any transformer requiring maintenance other than touch-up painting, is sent to the system shop when removed from service. It is there

that the oil is removed, core and coil inspected, repaired and flushed, the tank cleaned, and painted, gaskets and bushings repaired, reassembled and filled with reclaimed inhibited oil. The repaired unit is then subjected to complete electrical tests.

Overhead Line Materials

Most of the maintenance and salvage of overhead line materials is performed at the system shop. Usable conductors, lightning arresters, fuse cutouts, disconnect switches and group-operated airbreak switches are repaired, tested, and boxed or packaged for stock.

Conductors are re-reeled, using compression connections for splicing the smaller conductors, and using full-tension three-element preformed line splices for larger conductors where compression splices would interfere with proper re-reeling. Line hardware is inspected and, if in usable condition, it is repaired and painted. Switches are repaired, broken insulators replaced, operating mechanisms adjusted and made ready for re-use.

Substations

The 16 distribution substation crews perform the maintenance on the equipment in some 650 substations. This maintenance is co-ordinated by equipment engineers in the Electrical Equipment section of the system Transmission and Distribution Department. These engineers prescribe the frequency and techniques of maintenance and are available to the local forces for consultation or field assistance on a 24-hr basis.

A formula has been devised to determine when an internal inspection of circuit breakers should be made. This formula takes into consideration the type of breaker, the severity of the interrupting duty, the number of fault operations since the last inspection, and other special circumstances. This formula has been in use for five years, and since it enables maintenance personnel to make internal inspections at the optimum time, it has been well received.

A visual inspection of all substations is made by local inspection teams every two months on a regular schedule. This inspection includes an operation check of all circuit breakers and regulators, a check of battery condition and a visual inspection of the entire substation.

Insulators

We have used silicon grease, with considerable success on insulators in substations and on various devices, to prevent flashover in contaminated areas. We have experimented with it in substations near fertilizer plants, and chemical plants with heavy fall-out of various chemicals, including one with a fluoride which normally destroys insulator glaze. Preliminary reports indicate that this grease will prevent flashover for two or more years, and allow easy cleanup and re-application of grease.

Our most recent experiment with the silicone grease has been very gratifying. It is on substations close to the Atlantic Ocean. During extended dry periods, there is a build-up of salt deposits on insulators, and if these periods are followed with wet fogs, drizzles, or fine rains that often accompany "Northeasters", severe flashovers and outages occur. Depending upon the normal rate of build-up, a coating of silicone grease should be effective from 18 to 24 months for salt deposits. We plan to experiment with the hot line application of silicone grease on energized lines, although for new lines, over-insulation seems to be a better answer to salt deposits.

We have recently organized a new department to direct all tree and brush control work on our system. This work is under the direct supervision of the System Superintendent of Tree and Brush Control. We have in this department college-trained foresters and botanists who will specialize in this important field of our work. This group will direct the activities of all tree and brush control on our system and will help to train district employees assigned to this work.

Until recently, our Company had done very little in chemical control of brush on distribution circuits, but in 1959 a modest start of some 1000 acres was begun. Meanwhile, more than half of the transmission mileage is already under chemical control, and additional acreage is planned for both departments each year.

Patrolling Distribution Circuits

With manpower shortages during the war years, the patrol of distribution circuits was gradually curtailed, and the results of this curtailment have recently become alarmingly clear. We have already initiated the regular motor vehicle and foot patrol of certain important radial feeders, and we have recently made a survey which indicates the desirability of aerial patrol of selected sub-transmission feeders. We also have adopted the motor patrol of distribution feeders along

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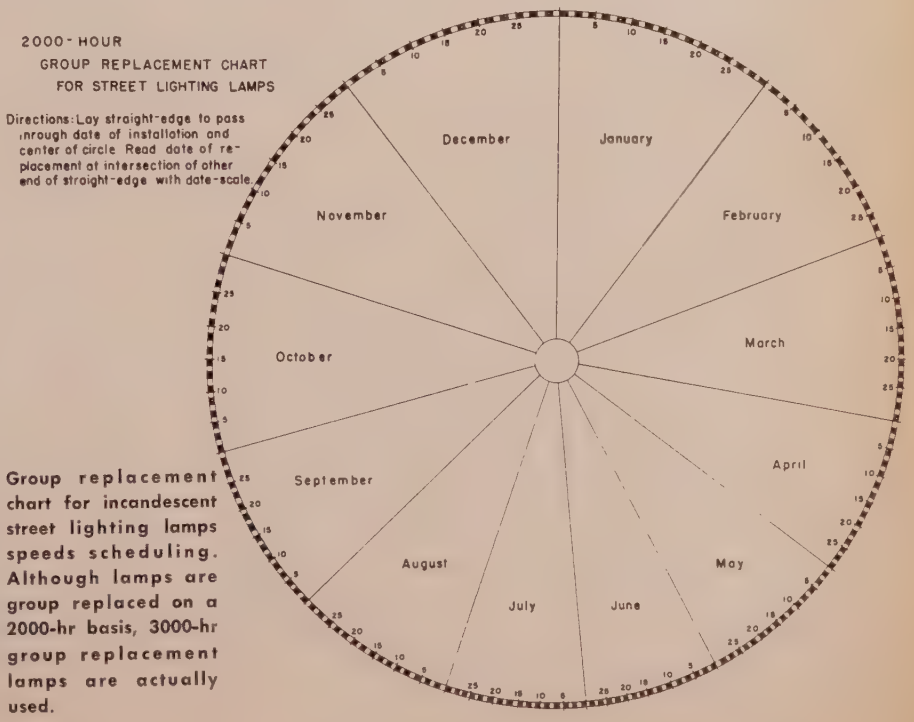


Group replacement chart for incandescent street lighting lamps speeds scheduling. Although lamps are group replaced on a 2000-hr basis, 3000-hr group replacement lamps are actually used.

VIBRATION PROBLEMS PLAGUE RURAL LINES

By J. C. POFFENBERGER
Assistant Director
Research and Engineering
Preformed Line Products Company

Measures available to counteract aeolian vibration and galloping of rural-line conductors have practical limitations. Case histories of notable field-vibration failures involving diverse types of construction illustrate many of the causes and effects of severe aeolian vibration and describe the remedial action taken.

LINE-COST REDUCTION methods employed to minimize capital investment in lightly-loaded rural lines have fostered problems as well as economy. Not the least of the problems are those associated with wind-induced vibration.

Two distinct types of wind-induced vibration cause difficulty on overhead lines—aeolian vibration and galloping. Although they are significantly different in physical configuration and cause entirely different types of damage, both forms of oscillation occur at one or more of the natural harmonic frequencies of the conductor. Of the two, aeolian vibration is by far the more prevalent and generates a great deal more damage on an annual basis, since it can occur in any loading district in any season of the year. Galloping, on the other hand, is confined, for all practical purposes, to those areas and seasons in which ice can accumulate on the conductors.

In assessing the problem with respect to rural line design, it is significant that many of the factors contributing to the severity of aeolian vibration in general are incorporated in almost every line serving rural areas. Included in the contributing factors are the use of:

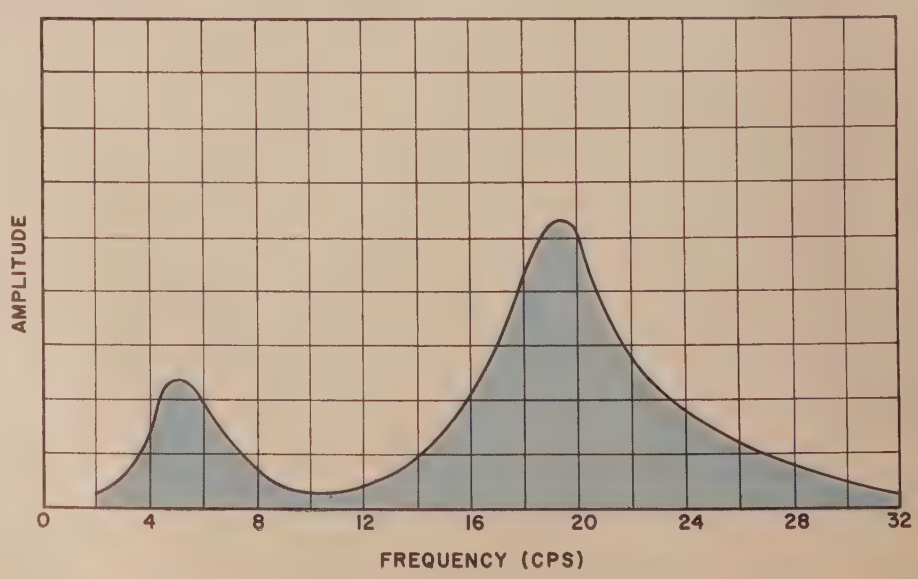
1. High unloaded line tensions.
2. Long spans.
3. Aluminum and ACSR conductors in place of copper.
4. Small-diameter conductors.
5. Light-strength ACSR conductors.
6. Right-of-way which traverses terrain devoid of natural obstacles to wind flow.

Since these same factors also contribute significantly to the over-all economy of line construction, it is pertinent to define their relationship to aeolian vibration in practical terms so that a line designer may readily evaluate them in establishing a proper balance between vibration severity and economy in line design.

Aeolian Vibration Problems

Aeolian vibration occurs almost constantly on overhead conductors and static wires of circular cross-section. Depending on the line characteristics and environmental ex-

Fig. 1—Typical frequency response curve of 12-lb Stockbridge damper. Data for curve accumulated from laboratory testing of three individual dampers under varying dynamic conditions.



posure, the vibration may vary from an extremely severe level to one detectable only with sensitive instruments.

For the purposes of this discussion, it is sufficient to state that aeolian vibration is manifested physically in a standing wave configuration and that in comparison with galloping, the frequency is relatively high, there are many loops from end to end of the span, and the loops have small peak-to-peak displacements, rarely exceeding a conductor diameter in magnitude. Additionally, the frequency of vibration increases somewhat proportionally with wind speed and is inversely proportional to conductor diameter.

The effect that line configuration, environment, and stress condition have on the severity of aeolian vibration and damage are listed below in an axiomatic manner:

1. The air movement most conducive to aeolian vibration generally occurs in open areas which offer few terrain features to break up the flow patterns of prevailing winds.
2. High unloaded tensions reduce the structural damping of a stranded conductor. This permits the cable to vibrate more readily and at higher frequencies.
3. High-frequency aeolian vibration, which occurs more commonly on smaller-diameter conductors, is difficult to suppress with dampers.
4. Dynamic flexural stresses resulting from the bending of the conductor into loops raise the combined stress level of the conductor when imposed on the static stresses of tension, bending, and clamping.
5. High tensions raise the base stress level of the conductor and reduce the range of dynamic stress that can be safely tolerated.
6. The stress-strain characteristics of ACSR have a pronounced influence on conductor vibration and damage.
7. The major portion of severe aeolian vibration occurs in the Light and Medium Loading Districts with the exception of those areas within the Heavy Loading District that have extremely long and cold winters.

Fig. 2—Damage on transmission line conductor at clamp of Stockbridge damper.

Fig. 3—Installation of special armor assembly over existing armor rods that had suffered tie-wire abrasion on #2 ACSR 7/1 conductor.

Abrasive wear at tied supports currently constitutes the larger portion of vibration damage.

Types of Damage

Broadly classified, the damage resulting from aeolian vibration may be divided into two categories, fatigue and abrasion, although it is possible for both to occur simultaneously. Both types of damage are progressive and long term in nature, but once initiated, abrasion usually becomes evident much more rapidly.

The different types of difficulties listed below include some items that have a relatively low incidence but are nonetheless important to the line designer because they do not represent isolated cases. Although not all-inclusive, the most widely encountered difficulties resulting from aeolian vibration are:

1. Fatigue breakage of conductors and static wires at:
   a. Support points.
   b. Rigid body splices and dead-ends.
   c. Other rigid hardware such as the clamps of dampers, taps, armor rods and aircraft warning spheres.
2. Severe abrasion of conductors and static wires at:
   a. Loose ties.
   b. Loose hardware.
3. Severe abrasion and fatigue breakage of tie wires.
4. Fatigue breakage of tower members—usually occurs in lightly-loaded redundant members. (Although a different form of difficulty, if high levels of audible tower noise seriously disturb nearby residents, public relations are often damaged.)
5. Fatigue breakage of pins of suspension insulators. (Failures generally occur at dead-end structures and within a few weeks of installation.)
6. Loosening of associated hardware such as: nuts or bolts of the structures, pins of pin-type insulators, and clamps of various line fittings.

Protective Measures

A number of precautionary measures to counteract aeolian vibration and its effects are currently available to the line designer and construction personnel. Since these methods vary in expense, complexity, and effectiveness, a brief description and qualitative estimate of the feasibility of each is contained in the following paragraphs.

Handling of Cable

Careful handling in the field to avoid scratches, cuts, or kinks in the conductors and static wires is desirable during the field operations of paying out, stringing, and clipping-in. Additionally, to minimize the possibility of conductor damage occurring in the sheaves, clipping-in should be carried out as

Fig. 4—Free-response dampers mounted on #2 ACSR 7/1 conductor to suppress destructive vibration previously encountered on the line.

Fig. 5—Severe indentations on field-damaged 4/0 ACSR 6/1 conductor resulted from high compressive forces exerted by clamp.

soon as possible after sagging. These procedures will not diminish line vibration, but will reduce the number of stress concentrations due to surface discontinuities, and are particularly desirable practices in the case of ACSR and aluminum conductors. The cost is low, since careful workmanship is required primarily.

Low Unloaded Tensions

The use of low unloaded tensions to reduce both the severity of vibration and the accompanying damage is a simple and generally effective measure. It can also be quite expensive! If used, this technique should preferably be carried out in the original design since resagging is costly and oftentimes impossible due to lack of ground clearance or scheduled outage time.

The historical vibration experience of lines of similar construction in the same geographical area may aid the designer in reaching a considered decision as to the necessity of using low tensions.

Armor Rods

Armor rods of any type are effective in reducing and distributing the stresses imposed on conductor elements by the combined static and dynamic forces encountered at the support points. In addition, they provide protection against the electrical burning of the conductor from flashovers. Where ties are involved, the protective sheathing guards against abrasion damage to the conductor. The additional expense is moderate.

It should be emphasized that armor rods do not suppress line vibration but merely counteract its effect. Additionally, armor rods do not insure complete freedom from conductor fatigue damage when extremely severe vibration is encountered on a long-term basis. Fortunately, vibration of this level is relatively rare, but when it occurs armor-rodded cables have many times the life expectancy of bare conductors.

Suspension Clamps

Use of well-contoured suspension clamps having generously proportioned areas for conductor support is effective in reducing the static and dynamic stresses on either bare or armor-rodded conductors and static wires. To further reduce the total stress composition, clamps that exert minimum compressive force on the conductor are useful. In this regard, the use of torque wrenches may forestall the natural inclination to overtighten clamp bolts in bad vibration areas. Depending on the alternate clamp designs being considered, the additional cost of a clamp embodying these desirable features may be nominal.

Other Line Hardware

Since the state of stress at dead-ends, tapping clamps, damper clamps, and splices is somewhat similar to that at a suspension clamp, it is desirable to protect the conductor from the high localized stress conditions associated with rigid body fittings. Short-length armor rods may be used for this purpose. In many instances, armor rods have been used to protect cables at bolted strain clamps, and the same technique has been used with compression dead-ends at critical river crossings. Although cost is moderate, it is definitely an added expense and historical experience in a particular locale may serve as a guide in using this technique.

Structures

Various types of lock nuts, lock washers, and special bolts are available from different manufacturers to combat the vibratory loosening of connections and joints. Their effectiveness and unit cost vary considerably. If the need can be anticipated, it is most economical to incorporate special fasteners in the original construction.

The vibration of lightly-loaded tower members may be minimized by increasing the stiffness ratio of the vibration-sensitive members. Since fatigue breakage of tower members is relatively uncommon, the added expense may not be justified.

Pins of Suspension Insulators

It is believed that severe overstressing of suspension insulator pins, either from overtensioning during stringing mishaps or from bending during erection, produces a condition of incipient failure that is quickly completed during the first weeks of operation, even though the vibration may be only low-to-moderate in level. Careful handling during construction should minimize these relatively infrequent cases.

Tied Supports

An effective tie should have the characteristics of tightness and low stress concentration and have the capability of remaining tight during severe vibration. Extremely good workmanship is required to approach these desired conditions, particularly if uniformity of installation from support to support is to be achieved. A number of different tie configurations are available and local experience may indicate

which type is most favorable for a given situation. The amount of lineman's time required at the top of the pole during installation is the primary cost variable.

Stockbridge Dampers

When severe vibration is encountered, dampers are often employed to suppress it. On a world-wide basis, a number of different types are available for use on overhead power lines, but in the United States the Stockbridge type has the most widespread acceptance. Although usually effective on the larger-diameter conductors, Stockbridge dampers are generally ineffective on small conductors and in many cases have actually proved detrimental. This disparity in effectiveness may be attributed to the frequency limitation of the damper and the adverse effect of mass concentration at any point on the span.

Actually, the Stockbridge device is a form of damped dynamic absorber with two principal modes of response. The frequency range of these modes varies with damper size, being higher for the lighter-weight sizes. Within their effective frequency ranges, these devices limit the conductor motion by establishing reactive forces in opposition to the exciting forces, but in themselves dissipate very little energy in the form of heat. A laboratory-determined frequency response curve for a 12-pound damper is shown in Fig. 1, and the limited range of the two response peaks over which the damper is effective may be noted.

Fig. 7—Close-up of conductor damage shown in Fig. 6. Extremely severe line vibration caused damage in little over a year.

Fig. 6—Damage to 900,000-cm 54/7 ACSR beneath armor-rod ends.

It is significant, however, that the response range covers fairly well the conductor vibration frequencies usually associated with transmission-size cables strung at moderate tensions and exposed to moderate wind speeds. On the other hand, the vibration frequencies of smaller diameter conductors under the same conditions lie beyond the effective range of even the smaller size dampers. Additionally, on tightly-strung spans even large diameter conductors may vibrate at frequencies higher than the damper's response, and fatigue damage of the type shown in Fig. 2 can result at damper clamps.

Incidentally, the frequency limitations of the damper should be taken into account in calculations to determine the optimum region of placement at a support. Dampers will function satisfactorily, within their own frequency limitations, over a relatively broad band of positions on the cable. Although precise location is not required, it is considered good practice to install the damper at least 6″ from the termination of other hardware to avoid compounding of stresses in the cable.

Because damper installations represent a substantial additional expense, a number of utilities install them only after the line has been operating for months or years and field observations have revealed the presence of severe line vibration on a continuing basis. Even then, trial installations should be made on representative spans to determine whether the dampers will be effective for the specific conditions of terrain, tension, and conductor size associated with the line. Selective placement of dampers on troublesome spans or sections of a line, rather than at every structure, has been employed successfully by Bonneville Power Administration as a cost-saving technique.

Galloping Of Conductors

Galloping of conductors occurs relatively infrequently in comparison with aeolian vibration but merits consideration because of its destructive effects when it occurs in serious form. The basic cause of the phenomenon is well known, and it is only necessary here to point out that the major portion of galloping involving overhead power lines is associated with ice-coated conductors, and the physical motion is characterized by low frequency, large amplitude, and a small number of loops (usually one to three) from end to end of the span. The oscillations can build up to amplitudes of 20 or 30 feet, and the large tensile forces accompanying the violent motion are responsible for a major portion of the physical destruction.

The Effect of Tension

Most of the reported cases of severe galloping that have come to our attention have been associated with lines having relatively conservative unloaded tensions. It has been our observation that galloping occurs to a much more limited extent on lines approaching the upper tension limit of either the National Electric Safety Code or the recommendations of cable manufacturers.

Types of Damage

The most common type of difficulty resulting from the extreme motion of galloping conductors is that of electrical outage and conductor burning resulting from contact of phase conductors.

Physical damage is caused by the large elastic forces developed in the conductors and structures during severe galloping. Various types are listed below:

1. Excessive sag from overstressing conductors or static wires.
2. "Bird caging" of stranded cables.
3. Tensile fracture of conductors and static wires.
4. Buckling of tower components such as goatheads, crossarms, and individual members.
5. Breaking of insulator ties and pulling conductors off the crossarm.
6. Fracture of wooden cross-

arms.

7. Complete collapse of structures.

Remedial Measures

At the present time, sleet-thawing arrangements for both the static wire and conductor appear to be the most positive solution in that ice accumulation is prevented. However, the expense involved makes this solution impractical except in the most critical areas.

Higher tensions or greater phase separation alleviate the most common difficulty of galloping, electrical outages due to midspan hits. Depending on the type of structure used, increased phase spacing may result in significant additional cost.

Hopefully, other solutions may be found in the future. An extensive research program on galloping is being co-sponsored by a number of utilities at Massachusetts Institute of Technology. A research engineer from an Eastern utility and his colleagues are working on experimental dampers to suppress galloping. Additionally, other organizations are directing their efforts toward the solution of this less widespread but important segment of the wind-induced vibration problem.

Summary

The nature and effects of aeolian vibration and galloping have been described, and factors contributing to the severity of wind-induced vibration on overhead lines have been enumerated.

Many currently available measures to counteract vibration or its effects have been tabulated and the practical limitations of each have been explained.

ILLUSTRATIVE EXAMPLES OF AEOLIAN VIBRATION

The examples cited herein were selected from a file of case histories to illustrate many of the statements made regarding aeolian vibration. Although chosen specifically to depict the seriousness of different problems associated with lines operating in a severe vibration environment, these cases are representative of conditions that can occur on other lines operating under similar circumstances. Since these particular cases are comparatively recent, it is believed that with but one exception they have not been described previously in the literature. These field examples involved diverse types of construction, but the characteristics of high tension and exposure to uniform wind flow were common to all.

#2 ACSR 7/1—Medium Loading District

A five-mile patrol along a radial feeder line in the middle of the night during a howling snow storm was required to locate a fault resulting from a broken tie which allowed a conductor to be blown off an insulator. The comprehensive line inspection that soon followed revealed the following: severe tie-wire and conductor damage at a significant percentage of conductor supports, conductor abrasion at "bird caged" aluminum conductor wires immediately adjacent to compression splices, and an apparent lack of static wire damage.

The line had been in operation four years and had experienced no previous difficulty of a serious nature except for two cases; one involved the dropping of static wire at a rigid splice location, and the other was associated with a conductor rebounding into the static wire after unloading heavy frost. Since the line is located in a region notorious for tie-wire difficulties and had experienced severe aeolian vibration in the colder months, the lack of previously-observed damage indicates that the original ties had been well-made. Some months after the inspection, a conductor parted a few inches outside a compression splice. The "basketed" aluminum wires had seriously abraded the steel core wire during vibration. Once the protective galvanizing had been eroded from the steel, the combined effect of corrosion and continued abrasion resulted in ultimate failure of the core wire and the conductor.

Although the line damage was no more severe than that associated with tied supports in other bad vibration environments, the remedial measures employed to repair the line were unusual and merit comment. Design and construction details are as follows:

Conductor: #2 ACSR 7/1 (ultimate strength = 3525 lbs).
Static Wire: #6-3 Strand–HTC 130 (clamps and armor rods).
Span Length: Generally 425 ft or shorter.
Structures: Wood pole.
Maximum Conductor Design Tension: 50% of ultimate strength under standard N.E.S.C. Medium Loading conditions in a 600-ft ruling span.
Minimum Temperature of Area: –40F.
Insulator: Line post.
Armor Rods: PREFORMED.
Terrain: Level, no shielding.

Since a scheduled outage could not be tolerated on the line, all repair work was done with hot sticks and no thought was given to resagging. At some supports the ties had worn completely through the hard aluminum alloy armor and had started to abrade the aluminum conductor wires; at other supports only the armor was abraded. Consequently, two different methods were used in repairing the damage.

Where only the armor had suffered tie-wire abrasion, new armor rods of special design were installed over the existing armor and new ties were made. (See Fig. 3) At those supports where the tie had worn through the armor and abraded the conductor, the existing armor was removed and helical-rod armor-splices were used not only to repair the conductor but also to restore armor protection.

A number of helical-rod, free-response, plastic dampers were installed on a trial basis to determine their effectiveness in suppressing vibration on representative spans. (See Fig. 4) The satisfactory field performance of the trial units led to the use of this type of damper at every structure, and no further difficulties have been experienced after the better part of a year's operation—including this past winter.

Small-Diameter Communication Line—Heavy Loading District

Although outside the scope of power line construction, many unusual aspects of this case relate directly to the design of small-diameter electrical lines.

An operational field prototype to test the feasibility of long-span construction practices was erected in a north-central state. Because of their unusual length, an above-average number of spans were dead-ended. For the same reason, little tension relief was provided at higher ambient temperatures. Pertinent construction details are as follows:

Conductor: 0.080" copper-covered steel with insulating jacket; over-all outer diameter = 0.110".
Span Lengths: 90% long spans ranging from 500 to 2000 ft; 10% short spans with a minimum length of 124 ft.
Structures: Wood pole.
Final Unloaded Design Tension: 25% of ultimate strength at 0F (ultimate strength = 1325 lbs).
Date of Construction: February, 1959.
Dead-ends and Splices: Compression type.
Terrain: Varies from level to very gently rolling; virtually no shielding, even by vegetation.

The serious problem that aeolian vibration would pose became apparent long before the line was completed. During the first two weeks of construction, the line wire suffered com-

plete fatigue fracture and dropped to the ground at 28 of the 100 dead-ends and two of the 50 splices. Vibration frequencies ranging from 100 cps to 600 cps, at amplitudes of twice the wire diameter and a single-wire diameter, respectively, were measured in the field with steady winds blowing across the line. An unusual characteristic of this line was that violent vibration and severe flexural strain continued even with high-velocity, unsteady winds.

In an effort to attenuate the vibration, free-response dampers of varying design and source of manufacture were substituted for the conventional telephone-line dampers originally installed, and plastic spacers were used to couple adjoining wires in order to obtain frequency-interference damping. The effectiveness of individual methods varied considerably and the most promising are still being studied to determine their comparative merit for future construction of a similar type.

Stress reduction was accomplished by the use of flexible, helical-rod fittings. At dead-end points, the original fittings were cut out and replaced with the flexible assemblies. At splices where no failures had occurred, the new fittings were designed and installed in such a manner that they provided a mechanical and electrical shunt around the compression device. Where complete failures had occurred, the original splices were cut out and flexible splices installed. The helical-rod fittings proved to be extremely effective, and after a year's operation there has been no fatigue damage where they were installed. To protect the line wire from further abrasion at tie and transposition points, armor rods were applied during the repair. They, too, proved effective.

In addition to the line's environmental exposure, the severity of the vibration was attributed to both the low structural damping associated with a solid wire and the relatively large ratio of the conductor's outer diameter to its unit mass. It is believed that the latter factor accounts in part for the increased vibration observed on light-strength ACSR lines.

266,800 CM 26/7 ACSR—Medium Loading District

After four years of operation, a significant amount of conductor damage was discovered on a radial feeder line extending across a broad river valley lying between two mountain ranges. The hot-line inspection of armor-rodded conductors which revealed the damage was initiated soon after a lineman observed that the cotter keys in suspension-clamp clevis pins were badly abraded at a number of supports and in some instances had failed completely and dropped to the ground. Salient features of the line include:

Conductor: 266,800 CM 26/7 ACSR (ultimate strength = 11,250 lbs).
Static Wire: ⅜" High Strength 7-wire galvanized steel.
Span Lengths: 900 ft.
Structures: Wood H-Frame.
Conductor Design Tension: 2600 lbs at 300 F (final unloaded).
Armor Rods: PREFORMED (conductor and static wire).
Terrain: Gently sloping valley; no shielding.

Throughout most of the year, gently steady winds in the neighborhood of six to eight miles per hour flow up or down the valley at nearly right angles to the line, and these had obviously caused severe aeolian vibration. During a field inspection by manufacturers, sustained, steady-state conductor vibration was observed; standing waves of almost laboratory severity were clearly visible from the ground. This was assumed to be representative of the conductor vibration occurring during the line's history. On the other hand, the steel static wire exhibited only a minor level of vibration during the inspection, and this, too, was assumed typical because of the lack of damage to the wire and its attachments.

Because hot-line techniques were necessary, only a few conductor supports were examined; however, each one contained a significant number of failed aluminum wires in both the inner and outer layers. All breaks were due to fatigue, and no abrasion or wear was evident. However, the indentations on the inner surfaces of the outer aluminum wires (where they contacted the reverse-lay inner layer) indicated that high compressive forces had been exerted by the clamp, presumably from tightening the bolts extremely securely. No damage was found in the steel core wire, and the armor rods used had provided the continuity of service required in a radial feeder line.

On the basis of field observation and wind-flow data for the area, it was believed that Stockbridge dampers would suppress a major portion of the destructive vibration and their installation was recommended. They were applied with hot sticks and proved successful in operation. No further difficulties have been reported on this line in five years.

4/0 ACSR 6/1—Heavy Loading District

The first indication of difficulty on this 2½-year-old line occurred when a center phase conductor failed in fatigue and dropped to the ground early one morning during the coldest January in years. A similar occurrence a few days later prompted a comprehensive inspection of the line; its characteristics are described below:

Conductor: 4/0 ACSR 6/1 (ultimate strength = 8420 lbs).
Structures: Wood pole.
Span Length: 425 to 475 ft.
Final Unloaded Design Tension: 25% of ultimate strength at 0F.
Minimum Temperature of Area: −35F (occasionally −40F).
Armor Rods: PREFORMED.
Terrain: Flat, practically no vegetation shielding.

Aeolian vibration had existed on the line since construction was completed, and was particularly severe during winter months when the temperature dropped below zero for extended periods. During a field inspection by manufacturers, steady-state standing waves of high frequency (nearly 100 cps) were observed for prolonged periods. Field measurements showed that the actual line tension was somewhat higher than designed, and it was a matter of conjecture as to whether or not the line had ever reached final sag. An engineer intimately familiar with the design of lines owned by a number of different utilities in the north-central area stated that tensions somewhat higher than usual had been adopted on this line to minimize midspan hits from galloping.

A thorough inspection from end to end of the line revealed that all damage was of a fatigue nature. Additionally, virtually all of the damage occurred on the center phase conductor. The support-by-support inspection showed damage ranging from one to six fatigued aluminum wires (as well as the two core wire failures involved in the complete conductor fracture mentioned above) at the center phase position on 30% of the structures. By way of contrast, damage was found at less than six tenths of one percent (0.60%) of the crossarm-supported clamps and ranged from one to three fatigued aluminum wires.

The center phase was supported at the pole top, and the slightly higher level of vibration measured there over several days was attributed to the greater rigidity of the mounting location in comparison to the crossarms. However, the major contributing factor to the severity of center-phase conductor damage was the high compression stress resulting from: (a) mounting the clamp keepers in an upside-down position, and (b) overtightening the clamp bolts to prevent their loosening under vibration. Severe indentation in conductor elements resulting from these two factors may be observed in Fig. 5.

Remedial measures took the following form: The line was re-sagged, and since ground clearance was available, tensions were lowered drastically. The fatigue-damaged conductor was cut out and adjoining sections spliced together. Additionally, undamaged areas under clamps were moved out into the span by virtue of the re-sagging, and armor rods were removed. New armor of the wrench-formed tapered type was then installed at all support points. The inhibiting effect of low tensions on vibration severity was immediately apparent through comparison with sections of the line that had not yet been re-sagged. It is assumed that the lowered tensions have been effective in attenuating the destructive vibration, for no reports of further difficulty have been received since the program was carried out a little over a year ago.

900,000 CM ACSR 54/7—Light Loading District

The line described below is not, strictly speaking, a rural line. However, it represents the most extreme case of line damage from aeolian vibration that has ever come to our attention, and further illustrates the effects of wind flow and tension. The fact that large conductors are involved makes the case

(Continued on page 118)

ULTRASONIC CLEANING BRIGHTENS STREET LIGHT GLOBES CUTS SERVICING

How Broadway Maintenance Corporation uses truck-mounted ultrasonic cleaning units to clean street light globes better and faster.

STREET light globes in New York City and Philadelphia are cleaned ultrasonically on the spot in truck-mounted units so that they are as clean as new globes. This has been proved by light meter tests, according to Broadway Maintenance Corp. (Long Island City, N. Y.), which has four trucks using equipment designed and built by Branson Ultrasonic Corp., Stamford, Conn.

Major Advantages

In addition to producing cleaner globes, which are more efficient and provide more light, these truck-mounted cleaners: (1) are much faster than hand-brushing; (2) eliminate many trips back to the plant to pick up clean globes and to return the soiled ones; (3) reduce record-keeping and capital tied up in replacements; and (4) require less servicing, because no build-up of dirt in crevices is possible.

Even after exposure to all kinds of East Coast weather for six months, a 30 to 60-second dip in an ultrasonically agitated tank is enough to remove all accumulated soils completely. Depending on location, globes are cleaned from two to four times a year. Previously, the contractor sent out a truck supplied with enough clean globes to replace dirty ones in a given district. Soiled globes then had to be returned to the plant for cleaning. Although hand-scrubbing was fairly quick, requiring about 1½ minutes for each globe, results were poor. Stubborn stains and grime were too hard to remove manually.

Many Types Used

Another problem was created because of the many types of globes used by the city. Each truck load of soiled globes meant extra storage and handling for the maintenance firm. And records of various light standards and globes had to be kept

almost on a block-by-block basis for the entire city.

Now, through the use of truck-mounted ultrasonic cleaning units, both cleaning efficiency and handling have improved. Just a few spare globes to replace broken ones are sufficient for each type of street light encountered during a daily run.

As the truck pauses beneath a pole, the maintenance man (either on a ladder or hydraulic lift) removes the dirty globe and replaces it with a clean one. The first globe then goes into the ultrasonic cleaning tank. By the time the truck reaches the next light, the globe has been cleaned, dried, and is ready to be reinstalled.

Large street light globes in Philadelphia are cleaned bright as new in ultrasonic cleaning tank mounted on Broadway Maintenance ladder truck using two men—one on the ladder, and the other cleaning globes in the ultrasonic tank and handing replacements to his partner.

No brushing or scrubbing is necessary with ultrasonics. From left to right on the ladder truck in Philadelphia are the ultrasonic generator, the cleaning tank and the 25-gpm filter. Rubber gloves protect the maintenance man's hands from the cleaning solution, which is heated to about 115 F.

How Ultrasonics Works

Each truck carries the following equipment: a gasoline-powered seven-kw, 220-v, a-c auxiliary generator; a 55-gal stainless steel ultrasonic cleaning tank; 25-gpm continuous-flow filter; and a 2.5-kw ultrasonic generator driving eight transducers, mounted at the bottom of the cleaning tank.

Ultrasonic cleaning's effectiveness stems from cavitation—the rapid growth and sudden collapse of millions of pressure cells in the cleaning solution. These implosions literally blast dirt and contaminants from any hard surface immersed in the ultrasonic bath. Line voltage of 220-v, a-c is transformed by the ultrasonic generator into electrical energy at 38,000 cps. This energy is fed into ceramic transducers mounted against the bottom of the cleaning tank, where it is converted into mechanical oscillations at the same frequency.

Mechanical, high-speed agitation of the cleaning liquid creates cavitation tiny voids, which, upon collapse, release tremendous energy. In effect, cavitation is the equivalent of millions of tiny scrub brushes within the liquid, which do the work quickly, efficiently, and without harm to the material being cleaned.

In New York, cleaning is done by one man, aided by a remote-controlled hydraulic lift. After installing a clean globe, the operator processes the dirty one while en route to the next lamp standard. A 30 to 60-sec dip in the ultrasonic tank is usually enough, even when globes have been in service for six months. The ultrasonic tank is mounted on its own hydraulic lift behind the truck's main platform.

Pittsburgh Next

Broadway Maintenance is so enthusiastic about the method, that they plan to shift one of the truck-mounted units from Philadelphia, where they were first tried out, to the Pittsburgh area. If the move is successful, additional trucks will be converted to ultrasonic service.

HOW PEPCO MOVED TWO 69-KV PIPE TYPE CABLES

Two 69-kv pipe-type cables were moved 1017 ft in connection with highway improvements without alteration to existing facilities. Job was made feasible by obtaining required slack in pipe by straightening out the profile.

By ARTHUR GANDY, JR.

Conduit Engineer
Potomac Electric Power Company

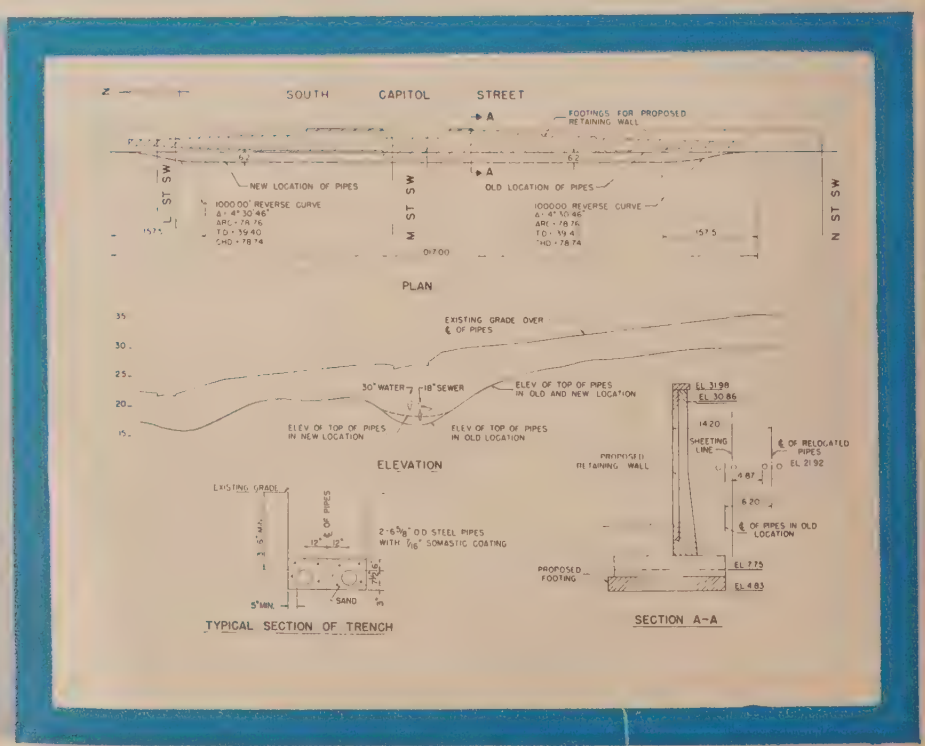
BY THE USE of 1000-ft reverse curves on each end of a 1017-ft relocation project the Potomac Electric Power Company recently relocated two 69-kv pipe type cables without cutting the pipes or removing and reinstalling the cables. The lines were moved to their new location and the job completed in just 36 days. The pipes moved very easily and did not tend to creep back to their original position. And the pipe coating did not crack, even with the temperature averaging 85 F.

The circuits involved are between the Potomac River Generating Station, Alexandria, Virginia and Ninth Street Substation in downtown Washington, D. C., a distance of approximately 7.5 miles. They consist of two 6⅝-in. outside diameter steel pipes, coated with a nominal 7/16-in. thickness of an asphalt mastic compound. The two pipes were installed with a horizontal spacing of two ft center-to-center and each contains three single-conductor 1500 MCM 69-kv cables under 200 psi oil pressure. Each circuit is rated at 90 MVA normal and 100 MVA emergency load.

Plans Were Changed

During the early planning of this line in December, 1955, preliminary plans of a proposed underpass at South Capitol and "M" Streets were obtained from the D. C. Department of Highways and Traffic. It was de-

This article was adapted from a paper presented by the author at the EEI T&D Committee meeting held in St. Petersburg, Florida.



Old and new location of the pipes in plan and elevation and the proposed footings. Section A-A shows the relationship of proposed footings, retaining wall and old and new locations of pipes.

termined that the route of the proposed pipe line parallel to the underpass would clear the footings for the retaining wall. Later, after the pipes and cables were in place, a revised preliminary plan was received showing the proposed underpass shifted 12 ft to the West, thereby extending the proposed footings approximately two ft past the centerline of the pipe lines. Notification was received in July 1, 1959 from the D. C. Department of Highways and Traffic that the underpass project would be started early in 1960 and to proceed with the pipe relocation as soon as possible. The centerline of the underpass was shifted 12 ft but with some modification in the footings.

Construction Problems

The problem at first seemed to be one that would require a long and expensive outage of the circuits to permit the cutting of the pipes and the removal and reinstallation of the cables. However, it was determined that a relocation of 6.2 ft for a distance of 702 ft would give the necessary clearance from the footings. It was decided the move could be made without cutting the pipes by using 1000-ft reverse curves on each end of the relocation which added only 0.32 ft to the length of the line.

The 1000-ft reverse curves were used to reduce the tension on the pipes to a minimum. This would also hold the increase in the length of the line to a minimum. It was not necessary to extend the 6.2-ft relocation for the entire length of the retaining wall due to the footings being narrow and shallow at each end of the project.

Two Methods

Two methods were available to obtain the slack necessary for the added length required in the move.

1. Hold the elevation of the pipes under "M" Street, which was 11 ft deep, and take the hump out of pipes north and south of "M" Street. This plan involved approximately 1200 cu yd additional excavation and backfill and would introduce additional work in moving and lowering instead of a straight horizontal move for a distance of approximately 800 ft.

2. Raise the pipes under "M" Street approximately 21 in. for a distance of 110 ft and hold existing

Exposed pipes with 1-ft offset stakes in place to indicate new location of pipe lines. This is at south end of project looking north.

Two truck-mounted cranes lifted pipe using canvas slings with pick-ups on 25-ft centers. Pipe was raised 1 in. and pushed over 2 ft by hand labor—then lowered.

Both pipes moved into new position and placed on sand bags to facilitate "jeeping" the pipe to detect "holidays" in the coating. Four small holes were detected and repaired.

Both pipes moved into position showing grade change and start of backfilling where pipes were originally located through the intersection of "M" street. Use of metal straps for supporting street mains was found to be very satisfactory.

Minimum of 6 in. of sand was placed over pipes and compacted with small mechanical vibrators.

Four concrete anchors were placed along the line to prevent pipe movement.

elevation for the remainder of the distance. This plan made it necessary to raise an 18-in. sewer approximately 20 in. for a distance of 30 ft.

The latter plan was selected as being the most economical due to the smaller amount of excavating. It involved easier handling of the pipe, and less work in grading a level bottom in the excavation except for the 110 ft where the pipes were to be raised.

Construction Details

The actual excavation, which was 12 ft wide and varied from 5 ft to 11 ft deep, was made with two truck-mounted cranes with ¾-cu yd clamshell buckets to a depth approximately one ft above the pipes. The remainder of the excavation was accomplished by hand digging to prevent damage to pipe coating.

Outage was taken on the circuit in the first pipe to be moved and oil pressure was reduced to 35 psi. Incidentally, one pipe was completely relocated and the circuit re-energized before outage was taken on the second circuit.

Two truck mounted cranes were used to lift the pipe using canvas slings with pick-ups on 25-ft centers. This was accomplished by centering the pulley on the boom approximately two ft past the center of the pipe being moved. Pipe was raised approximately one in. and pushed over approximately two ft by hand labor and then lowered. Cranes moved along the excavation in 50-ft jumps until each incremental move was completed.

Slack In Line

To obtain slack in the line, the pipe was first raised and moved, at the low point in the line, in small steps by the use of sand bags. This process proved very satisfactory as the pipes moved very easily, no apparent strain or tension was in evidence.

Backfilling was immediately started in "M" Street to permit restoration of the roadway surface to facilitate the opening to traffic as quickly as possible. Four concrete anchors were placed along the line to prevent pipe movement. Backfilling was then completed using mechanical tampers and rollers.

Construction Feats

Excavation was started on September 2, 1959 and completed on September 25, 1959, without any rainfall, although some was experienced later during the relocation and backfill work.

"M" Street was closed to traffic on September 22nd and opened on October 9th after 14 working days.

First pipe relocation started at 8:30 am, on September 29. Work progressed in an orderly manner, even with a brief hard shower, until 11:15 am. At that time, circuit was ordered energized by the power dispatcher due to load conditions on the system caused by the extreme heat and high humidity after the morning rain. Work was stopped for the remainder of the day and resumed on September 30th. Total working relocation time was 7½ hr for the first pipe. The second pipe was moved in 6¾ hr on October 2nd.

Pipes were "jeeped" and repaired in two days, October 2nd and 5th. Anchors were poured on October 3rd. Backfilling started on October 5th and was completed on October 20th, 36 working days after the job was started. Backfilling was slowed by several rainy days in October.

RMEL Convention Speakers Stress Its "Planning For Progress" Theme

A look ahead at industry challenges and what can be done about them was afforded delegates to the Rocky Mountain Electrical League's 1960 Annual Convention at Denver, Colo.

In his opening remarks, League President R. T. Person (president, Public Service Co. of Colo.) characterized speakers appearing on the program as men of established leadership, providing opportunity for those attending to gain a broadened viewpoint, perspective and general outlook.

Speaking on "Where We Are Now—And Where Going?", EEI President Sherman R. Knapp (president, The Connecticut Light & Power Co.) declared that "our whole approach needs a rough, tough going over—from kilowatts to customers, toward a proper public understanding of the tremendous contribution of the shareholder public utilities." He stressed that semantics is a problem and cost of money is an inequity but tax equality certainly ranks with equality of opportunity and equality of treatment under law.

Mr. Knapp warned that if democracy is to grow and prosper and be able to resist the force of communism, it is vital that two important fundamentals be maintained in this country, namely equality of opportunity and equality of taxation.

"America stands now on the threshold of progress seeking to determine the direction to take in the next phase of growth," declared Edwin Vennard, EEI vice-president and managing director. "The way is not well marked and our chance of error is great," he warned, adding that "the Presidential election this year involves a decision which may be the beginning of a long-range development. It will indeed be a major crossroads."

Mr. Vennard presented much supporting evidence that America's electric power companies have made sound, responsible and practical plans for meeting the country's future power needs. "In the power field the free economy method of financing works and works well," he observed. "The more we deviate from that principle the more we gravitate towards a government-planned economy."

Reasons why the power issue should not be a political issue were analyzed by William M. Longman, president of Central Surveys. He reported that voters pay scant attention to stands taken on the public-power issue by the candidates they are voting on. As evidenced by voting records on the same dates in such states as Oregon and Idaho, votes on specific public power proposals do not correlate with votes on congressional or senatorial candidates identified with public power, he noted.

Economic growth cannot be controlled by monetary policy, observed Delmas Cawthorne, financial economist for the Tenth Federal District. He cautioned that all must act with an image of responsibility in our economic policy. Referring to today's "cost-push" inflation, he called attention to the fact that those industries that do not have a growth in productivity must increase their prices in order to meet wage advances.

"The 60's will soar," declared John J. Anderson, marketing manager for Westinghouse's Major Appliance Division, but he warned that although the dollars will be there, "there is no mathematical certainty that we will get them." Relative to discretionary income, he said "we are getting a slice of a bigger pie but the proportion of the slice is getting smaller."

Even more versatile appliances with much less complication are in sight, according to Mr. Anderson. He pointed out that if all the features of all the makes of washers of ten years ago were built into one unit it wouldn't have all the features of the product of any one of those manufacturers today.

"However," Mr. Anderson cautioned, "we are so busy looking ten years ahead that we are stumbling over a gold mine. 'Stickshift' appliances, in the age of automatics, are still with us in too many homes."

Taking as his theme "How Do You Rate," G. C. Rawls, president, Louisiana Power & Light Co., said "our companies find themselves facing an entirely new area of thinking, new customers with new ideas requiring fast footwork on our part to keep pace.

"The problem of relations with

Neil Simpson, left, RMEL session chairman (president and general manager, Black Hills Power & Light Co.), chats with speaker Delmas Cawthorn (center), financial economist, Tenth Federal District, and Donald T. Spangenburg, director of advertising, Public Service Co. of Colo., and program chairman for the convention.

Outgoing RMEL President R. T. Person, left (president, Public Service Co. of Colo.), congratulates incoming president P. E. Brookover, vice-president and general manager, Cheyenne Light, Fuel & Power Co.

our own employees has never been as important, and we find these employees with many more interests in life than existed a few years ago. But conversely, they are mixed up in more community undertakings and there is more opportunity for them to help us—if we teach them how to do it."

Development efforts on direct conversion of energy into electricity were discussed by James F. Young, general manager of G-E's Electric Utility Engineering Operation, New York. Four specific methods of conversion are being given increased attention, he reported, namely thermoelectric, thermionic, magnetohydrodynamic and fuel cells. He pointed out that these new concepts face extremely severe competition in bettering modern power-generation methods. Also, these new methods face the economic disadvantage of the cost of conversion equipment.

A progress report on the high-

James F. Young (left), general manager, Electric Utility Engineering Operation, General Electric Co., New York, told the RMEL Convention of prospects for unconventional power. Warren A. Terry, right (vice-president and general manager, Home Light & Power Co.), presided at one of the RMEL sessions.

temperature gas-cooled reactor was given by Corwin L. Rickard of the General Atomic Division of the General Dynamics Corp. speaking in behalf of Titus G. LeClair, Nuclear Power Application manager for this Division, who was in Europe at the time. A large part of the required research and development work on the Peach Bottom 40,000-kw prototype plant is already completed, he said, although construction is not scheduled to begin until next year. This plant is to be built for Philadelphia Electric with co-operation of 52 other utilities throughout the U. S.

Development progress will now make it possible to use high-temperature graphite fuel elements for the initial loading of the reactor, Mr. Rickard reported. An in-pile loop for testing a fully-assembled fuel element is nearing completion and the "critical facility" has been built.

Ultimate cost of the HTGR de-

G. C. Rawls, president, Louisiana Power & Light Co. His RMEL subject was "How Do You Rate?"

velopment program is expected to be about $14.5-million, according to Mr. Rickard, and is requiring the effort of about 200 scientific and engineering personnel at General Atomic.

At the closing session, P. E. Brookover, vice-president and general manager, Cheyenne Light, Fuel & Power Co., was elected as RMEL President for the coming year.

Power Plant Automation Highlights National Power Conference

The subject of power plant automation took the spotlight at the National Power Conference held September 21-23 in Philadelphia. One entire day with eight technical papers and lengthy discussions were devoted to this important and timely subject. Almost 900 engineers and businessmen attended the three-day meeting, jointly sponsored by ASME and AIEE.

C. L. Linder, vice president, General Electric Co. and president of AIEE told the group that engineering societies have a tremendous responsibility to make possible a good forum for the exchange of technical information. There is an urgent need to find a new set of focal points to organize and establish unity in the industry, he stated.

General Philosophy

According to W. L. Chadwick, vice president, Southern California Edison Co., 120 days of lost operation of a major generating station unit saved by computer control during its operating life will more than pay for the whole computer control installation. All savings of power replacement costs are in addition. He said that, for new installations, important savings can be made in operating labor. Maintenance and repair costs can be lowered through earlier determination of faulty conditions and more prompt correction. The more constant supervision of temperature changes, possible through computer control, will extend equipment, lower maintenance and fuel costs, Chadwick said.

Systems Approach

The systems approach to a computer-controlled generating plant was discussed by W. M. Gaines, L. F. Kennedy and A. M. Spielberg of General Electric. At present, there is no such thing as an ideal and universally acceptable automation system. Each system must be tailored to meet the specific needs of the user, Gaines stated. Programming is an art that requires skill to prepare the logic which utilizes the commands and operations in a manner to accomplish the desired objectives. The first unit will require many more man-hours than later ones—perhaps several man-years, according to Kennedy.

Automatic Boiler Operation

If the computer is provided with the correct monitoring and sensing devices, and if it is programmed to take into account every conceiv-

able eventuality that can occur during boiler operation, it can prevent furnace explosions or other casualties by either correcting the conditions or by tripping out pieces of equipment, or the entire unit, before damage can occur, said D. E. Heyburn, Babcock and Wilcox. The benefits of safer and more economical operation, lower maintenance, and higher efficiency must be weighed against the disadvantages of complexity, unknown reliability, and increased costs. Supporting equipment must be made more accurate, sensitive and reliable to realize the optimum benefits of automation, Heyburn stated.

Turbine Generator Automation

At present there has been little desire to eliminate any of the established closed loop systems of control functions on the basis that the digital computer should perform these functions, stated E. G. Noyes, Westinghouse. Rather, he said that the use of sub-control loops is being extended. The automatic steam plant will not be limited by the computer but rather by man's ability to plan and program for all possible contingencies. Even though a number of plants make use of a digital computer for data logging and process calculations, the automatic computer controlled plant is still in its infancy with the entire industry looking forward to the first successful operating reports, Noyes said.

Automatic Burner Controls

While there are still some problems which have not been solved, results to date after eight years experience indicate that automatic burner controls may be installed on most burner and furnace designs, burning any combination of the three major fuels, in the opinion of Ross H. Forney, vice president, Forney Engineering Co. But a systems approach is required to insure ultimate success in the design of the system. The basic philosophy must be well planned and accepted before definitive specifications can be written, he said.

Performance Calculations

T. W. Jenkins, Jr. and I. A. Kunzman, Jr., Leeds & Northrup, described an on-line digital computer for performance computations and discussed factors affecting the accuracy of these computations. A computer of this type is being installed for two units at Public Service Electric & Gas Company's Bergen Station. This application is not intended to make the fullest use of an inherent advantage—the ability to make logical decisions. This characteristic, coupled with the successful application to the monitoring of performance, indicates the potential of this type of computer for the automatic plant, Jenkins said.

Computer Application

Computer application to power plant automation was described by F. V. Lyle, Daystrom, Inc. He said that the computer system can help the operator by: providing better and more complete information in easy-to-use form; sequencing operations during start-up and shutdown; and improving operation by supervising the normal control system.

Organization and Management

According to W. T. Hess, vice president and chief engineer, Louisiana Power & Light Co., the probable maximum capitalized value of potential gains for computer control at the Little Gypsy plant is estimated to be $2,275,000. This figure was broken down as follows:

1. Reduction of major mishaps—$1,500,000
2. Increased fuel economy—$175,000
3. Reduction of manpower—$500,000
4. Reduction of maintenance—$100,000

The estimated cost for providing computer control above the cost of a monitoring and results computer is $630,000, said Hess.

The computer at the Company's Sterlington Station has proven to be the most reliable piece of equipment in the station. Hess insisted that he would still install computer control at the Company's next plant even if experience at Little Gypsy proved that it was not economical.

Integrating Generation and Transmission

In the opinion of W. D. Marsh, General Electric, the development of computer techniques for the selection and performance calculation of transmission systems has not progressed to the point where they can be considered part of an "automatic" planning process. It is possible to devise short cut techniques, but these represent compromises with good transmission planning which are too serious to be adopted merely for the purpose of securing automation, he declared. The best system planning will be achieved by experienced planning, men making intelligent use of the most accurate and realistic analytical tools available, Marsh said.

Generation Design Innovations

In describing the electric generating stations of Public Service Electric & Gas Co., R. A. Baker said that with the rapid increase in cost of austenitic steel, it could not now be economically justified for piping

AIEE President, C. H. Linder, vice president, General Electric addresses luncheon meeting. Seated (l to r) are W. C. Astley, ASME Co-chairman, Harold Foote, president and chief engineer, Commonwealth Associations, and R. L. Halberstadt, Bell Telephone, luncheon chairman.

and related equipment. For this reason the design temperatures of his Company's newest unit will be reduced to 1000/1000 F, 3500 psi, instead of the formerly used 1100 F. This will permit the maintenance of their present design efficiency level, while making a significant reduction in installed cost of the unit. As soon as it is found economical to install the necessary materials, the Company will again design for the higher temperatures, he said.

Wherever feasible, PSE&G has turned to the use of aluminum and concrete for permanence, good appearance and minimum maintenance, Baker declared. All outdoor floor grating, fences and gates, stair treads, pump enclosures, boiler casings, demineralized water storage tanks, buses and supporting bus structures are now aluminum. The use of aluminum was based on actual experience and the cost of other materials, he said.

Quality Service Needed

The efforts of all those concerned with electric power—utilities, consulting engineers, manufacturers

ASME Prime Mover Committee Award is presented by ASME President, Walker L. Cisler, left, president of Detroit Edison, to James H. Harlow, Philadelphia Electric, (for pioneering development work with super-critical pressures at the Eddystone plant).

and industry's own power and production engineers, operators and management, must constantly be coordinated, said R. W. Worley, United Engineers and Constructors. This cooperation eventually will make possible solutions to most mechanical and electrical problems and the frequency of electrical power disturbances will be reduced to the absolute minimum, Worley declared.

In outlining what Gulf States Utility Co. is doing to provide quality service to attract industry to its area, L. V. Dugas described his Company's two rates which were designed to be low enough in cost to entice industry, yet flexible enough to render the quality of service required by some companies. Y. L. Hughes, also of Gulf States, said that the growth and life expectancy of the power sales efforts are directly proportional to the engineering people's ability to:

1. Reduce generation costs.
2. Reduce transmission and distribution line and substation costs.
3. Plan intelligently.
4. Provide service continuity.
5. Establish reasonable working policies between Company and customer.
6. Work wholeheartedly with customer in his planning.
7. Supply customer information promptly.
8. Keep all promises made.

Hughes stated that Gulf States has found that it is considerably less expensive to serve industrial customers at 69 kv than at 138 kv, provided there is a choice, or unless the customer's load requirements are very near 100,000 kva.

Minimizing Disturbance Effects In Chemical Plants

One of the major reasons for turning down site locations for chemical plants is the lack of quality electric power service, according to M. M. Gilbert, Du Pont. It is very difficult to convince utilities that chemical plants require a higher degree of service continuity than the average industrial plant, he said. In some of today's automatic processes, even a 30-cycle interruption may take hours or even days to restart the plant, Gilbert contended. The customer should design into his own electrical system means of riding through the voltage disturbances that are beyond the control of utilities, whether caused by the utility or the customer, he said. Du Pont has found that 5-amp direct tripping on low voltage unit substation type breakers gives highly satisfactory results. They are easy to calibrate in the field and are quite accurate, Gilbert stated. About 200 of these units have been installed to date.

Award by Prime Mover Committee is presented by Walker L. Cisler, left, president of Detroit Edison, to Sigmund N. Fiala, American Electric Power, for paper covering pioneering development on the Philo super-critical pressure steam electric generating unit.

Integrated Steel Plant Power Service

H. L. Halstead and H. D. Ruger, Bethlehem Steel Co., discussed the electric power requirements of their Sparrows Point Plant, which has its own generation but is interconnected with a multiple circuit from Baltimore Gas & Electric Co. For adequate capacity the effective capacity of this interconnection together with the installed capacity at the plant must be sufficient to meet the maximum plant electrical load when the largest circuit of the interconnection or the largest boiler at the plant is out of service, they asserted.

Testing Boilers

In code testing large coal fired utility boilers, the input-output efficiency is, at present, the right efficiency, in the opinion of J. A. Bostic and W. F. Long, Cleveland Electric Illuminating Co. If enough work is done to find the unaccounted-for, it will be found not in the input-output efficiency, but in the heat losses, they contended. Heat-loss efficiency testing is, with the possible exception of flue-gas analysis equipment, easy to find, relatively inexpensive to install, and fairly easy to use. The only problem is that it does not, as yet, give the correct answers, they said.

Turbine-Exhaust Losses

The turbine-exhaust losses form a considerable portion of the total fluid-dynamic losses of a steam-turbine cycle and therefore represent a large source of potential improvement in over-all turbine performance, said C. E. Seglem and R. O. Brown, Westinghouse. The

reduction in hood loss resulting from new design exhaust hoods, is equivalent to approximately 0.3 to 0.6% in turbine heat rate, they stated.

Improving Thermal Efficiency

In the opinion of P. H. Knowlton, Jr., General Electric, there is an enormous field for further progress in thermal efficiency. The major problem is to choose the most fruitful line for further work. There has been steady progress of about ½ point of thermal efficiency per year in approaching the 40% level which has not quite been reached. It will be a real challenge to continue the progress above this level, Knowlton progress above this level, he said.

Thermal Stress Protection

Maintenance problems which occurred as a result of using improper starting procedures have been materially reduced at Baltimore Gas & Electric Co., according to R. H. Reisinger and C. B. Scharp. The development of improved starting procedures to provide maximum protection of turbine metal parts from temperature shock resulting in thermal stress, was the reason for this, they stated. In addition, the boiler superheater and generator-rotor limitations and requirements are recognized and integrated into over-all starting procedures that provide effective protection.

PEA System Planners View 460-kv Line

Main order of technical business at Pennsylvania Electric Association's System Planning Committee was a mental and physical look at Pennsylvania Electric's 460-kv experimental line. The meeting at Bedford Springs, Pa., on October 10-11 also reviewed various methods of shopping-center power supply.

Six Panelec men presented technical aspects of the 460-kv line. Their presentations were followed by a tour of the 13-mile line which crosses two mountains and a valley.

Combined tests and operational phase of the project will continue for the next two or three years, according to A. M. Baker, substation design engineer. "It continues to be Penelec's aim to be as practical as possible in this venture—to refrain from the strict research aspects and indulge in this manner only within the limits of our present equipment and design, and sufficiently beyond to confirm the present design wtih adequate margins of safety to equipment, personnel, operations, reasonable voltage increases and to provide sufficient references for the design of future similar or other EHV lines," he said.

The 12 types of structures were described by W. R. Cover, assistant transmission engineer. Included are wood structures which consist of four-pole tangent structure, 15 to 30 degree angle structure, and dead end structure. Tubular steel structures consist of guyed H-frames, portal type H-frames, running angle structure and and dead end structure. Laminated wood structures are conventional H-frame. Steel towers are free-swinging suspension, center-phase restrained suspension and dead end angle.

P. Pasternak, project engineer, described the two substations. All switching under load will be done with a 115-kv oil circuit breaker at each substation.

Relay protection utilizes standard impedance, distance and transfer-trip schemes in new and special combinations specifically for the line and terminals. W. W. Turner, relay engineer said that two telephone circuits will be used. The 460-kv primary line relaying is initiated from high-side current transformers and bushing potential devices. The carrier-type ground relay used in the permissive over reach scheme, is initiated from 460-kv side currents and potentials and is set to protect for faults far beyond the remote terminal. The ground back-up relay utilizes 115-kv breaker currents and 460-kv potentials.

Conventional metering schemes are used.

On radio influence, R. J. Bacha, junior engineer said, "no attempt will be made toward a strict theoretical assessment of radio influence. Only specific effects will be considered: Line-generated RI on local radio frequency communication service; (2) Induction—line voltage load and charging current coupling to other power and communication circuits in the vicinity; (3) Weather effects; and (4) Line hardware, and all other electrical and physical parameters which may cause or effect the attenuation and propagation of radio influence."

Extensive field investigations of lightning will be made on the line, according to D. L. Berkey, junior

One of Penelec's four types of 460-kv conductors is examined by (from left) outgoing Committee Chairman C. Morrison, Potomac Edison, Meeting Coordinator I. L. Phillips, Penelec and incoming Chairman W. U. Baum, Pennsylvania Power and Light.

engineer. Needed data on lighting current amplitudes, waveshapes and the resulting voltages will be sought. Thirty-five line surge oscillographs along the line, a specially-equipped laboratory truck, still cameras, boys cameras, and magnetic links on all 70 structures will all help in lightning data gathering. Preliminary studies have been made on tower models in cooperation with General Electric Co.

Indiana Electric Association Promotes Better Customer-Company Relationships

"We are shirking a management obligation if we permit our employees to go about their daily work unaware of investor-owned company responsibility to inform customers of the industry's magnitude, cooperation on large projects, power pooling, construction of major transmission lines, and nuclear power interests," said Carl D. Rees, president of Indiana Electric Association at the 51st Annual Convention in French Lick, Indiana, October 28-30. He is vice-president, general operations, Northern Indiana Public Service.

"Public apathy on the one hand, and the increasing tempo and vigor of the Public Power Group on the other, leaves us no alternative but to continue our efforts to fight with renewed vigor and intelligence," he urged.

Public Power Paradox

What seemed to Edison Electric Institute President Sherman Knapp of Connecticut Light and Power ". . . a plain confession that when government goes into business, it does not trust its ability to operate on a sound business basis," was brought out when he cited a May 5 American Public Power Association speech by Northcutt Ely, General Counsel for APPA. Mr. Ely had said, "There is nothing in the Federal Constitution which specifically immunizes the states or their political subdivisions from federal taxations." And he went on to say, "The results to public power would be catastrophic if the interest on municipal bonds, or the income of publicly-owned utilities should be subjected to federal income taxation."

Yet on the same day of the meeting, APPA stated "Whereas, the Federal Government may not constitutionally tax the income of the States and their political subdivision . . ." but then resolved to oppose any legislation which would impose federal income taxation on local government power. "This after they had said it was illegal, unconstitutional, and couldn't be done anyway," remarked Mr. Knapp.

He said because four out of five who pay electric bills pay 23 cents in taxes for every dollar on the bill, the customer who doesn't pay this tax collectively constitutes a huge tax loophole through which slips more than a half billion dollars a year which should be flowing into the coffers of local, state and federal governments. He said that the only way this loophole could be plugged was by personalizing the tax equality issue.

"It is up to us, every employee in every company, to understand the situation; to know and believe the answer to explain the practical, personal, and political threats of government power to every customer, neighbor, relative and friend. Only by arousing awareness, can this 'massive misunderstanding' be corrected," he urged.

Stocks Liked Now, But . . .

"Recent months show that the investing public has a great deal of confidence in utility stocks," said Harold H. Young, Eastman Dillon Union Securities, and Co. "But this is not a time for mutual congratulations. It may not always be so," he warned. He said some people don't like utility stocks because they fall into the categories of regulated industry, threat of government ownership, sensitivity to high interest rates, and others.

He advised, "everybody in your company should be working on customer relations." He also stressed good reporting which includes a good annual report, information in quarterly stock dividend envelopes, and that companies should take pains to get information to security analysts and call on big stockholders periodically in person. Professional investors should be invited to tour the territory, too.

The security man on visit looks for the following: physical property condition including good housekeeping, area development programs, attitude of personnel and their confidence in those higher in management. Among other things looked for are courtesy of superiors, community effort by officers and employees, employee training, how many officials and directors are stockholders, and how aggressive is loadbuilding promotion.

Future Power Answer—A Mixture

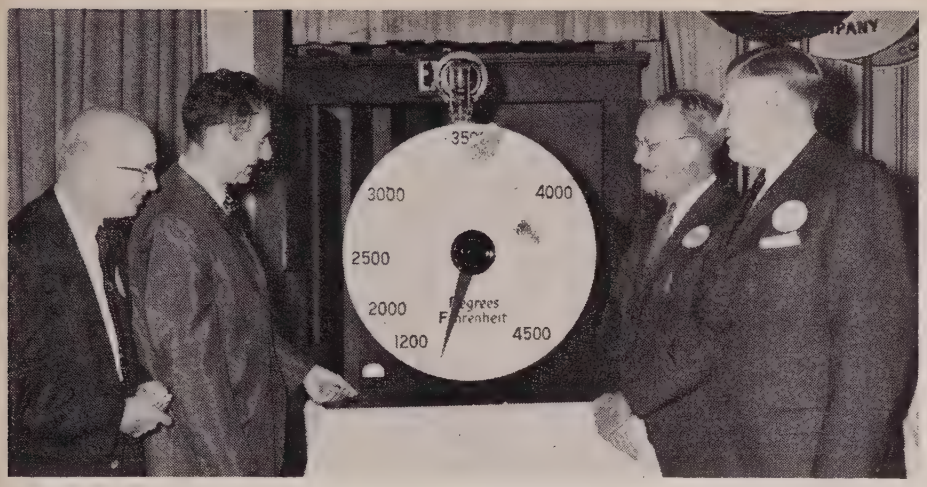
While Dr. S. W. Herwald of Westinghouse Electric Corp. discussed the four methods of future power generation now under intense scrutiny—thermoelectric, thermionic, fuel cell, and MHD—he said that "No *one* method, new or conventional, is likely to fill the increasing and varied need for electrical energy; no *one* method is likely to be the 'one way to do it.' That is why we must maintain a broad program of research in this whole area of energy conversion. Equally important, that is why we must have the engineering follow-up that will look at all feasible methods and exploit to the fullest the unique characteristic each one provides."

Manpower Cost

Cost of manpower and its control is everybody's responsibility, said John C. Arnell, director of industrial relations, Consolidated Edison. He presented statistics from 63 companies which described their manpower cost factors and measurements.

"Effective utilization of our manpower, aiming at greater productivity, is emphasized by many companies as the crux of the manpower cost control problem. But when you get into the area of labor productivity, how do you measure it in our business? How do you evaluate manpower costs? We would all like that answer.

"Effective utilization of manpower might be covered by the following simple statement: The ideal is to employ just enough of the right kind of well trained people, working hard enough to meet the day to day



Temperatures required for exotic methods of power generation are demonstrated by S. W. Herwald, Westinghouse Electric Corp. (second from left) to (from left) H. H. Young, Eastman Dillon Union Securities Co., newly elected IEA President R. E. Doyle, Jr., and J. C. Arnell, Consolidated Edison.

demands of the department.

"With the vast amounts of new capital that this industry will require in the decades ahead, the competition for new money will continue to be vigorous and the need for maintaining earnings equally rigorous. We dare not, in the negotiation of our working agreements, or in the administration of them on a day to day basis, weaken our right to expect a fair day's work for a fair day's pay, our right to set new work standards which are realistic, our right to change working methods or job duties, our right to promote those most capable and our right to subcontract work.

"Looking at what companies are doing toward more effective manpower utilization we find that it is being accomplished through improved work methods, reorganization, mechanization and automation as needs are indicated. Cost conscious companies are planning more training for management and supervisory employees. Employees are being motivated to do a better job through accelerated training, communications and even encouragement to train themselves.

"In short, we must keep our costs of operation under control by the constant application of intelligence, understanding and teamwork," he concluded.

Standards, Work Measurement, Testing, Safe Practices Discussed by EEI—T&D Committee

Latest developments in overhead and underground system design, construction, and operation were reviewed by the EEI—T&D Committee at its 83rd general session held in St. Louis Oct. 6-7. H. E. Cody, Cleveland, presided, and Past Chairman W. M. Penney welcomed delegates to the meeting which featured extended question and answer periods, and a more thorough probing of problems under discussion.

H. L. Williams, Cleveland, initial speaker at the underground session, described a recent d-c cable fault and manhole fire on his company's underground system. Faults on the d-c system, he said, usually have to burn clear because loading is only one-third system-design loading and fuses do not blow. The incident led to a review of all d-c cables to try to prevent a reoccurrence, and it furnished a documentary to prove that underground is not always the "maiden's dream," immune to difficulties. The outage also prompted installation of ventilated manhole covers and a junction-box-cleaning program.

Presenting conclusions of a soil-resistivity study, L. Fink, Philadelphia, said the problem had proved more difficult than anticipated because of moisture migration, evaporation, precipitation, and many other variables which lessen the value of any empirical formula that might be developed. He recommended advance study of proposed cable routes, proper trenching, careful analysis of backfill, firm packing of backfill, and further research. Importance of the problem, he said, may be realized from the fact that a 100-percent increase in resistivity will result in a 25-percent loss in capacity.

B. W. Hafeli, Detroit, described his company's direct-burial underground service in several residential subdivisions and trailer parks where it was possible to hold costs close to unity, compared with overhead service that would otherwise be required. Doing all of the trenching at once for joint-service occupancy, he said, has the advantages of forcing coordination, avoiding accidental dig-ups, and making a "packaged deal" with the atmosphere of a single job. For these installations subdivision developers furnished trenching, the utility supplied the primary system and transformation, and the property owners paid for their own secondary service cable.

Reports of cable testing procedures by T. C. Duncan, D. F. Tulloch, and A. Zanona led to discussions of advantages and disadvantages of testing which were inconclusive. Some conferees reported lessening of service outages and control of the time outages take place as a result of testing. One said that test failures plus service failures made a larger total of failures than would have occurred without testing. Another reported that testing or not testing was a stand-off economically because of inaccessibility of cables.

Case for Standardization

Advantages to be derived from a continuing standardization program, according to R. G. Steiner, St. Louis, are: 1. Freeing engineers for more creative work; 2. Broader application of non-professional employees; 3. Reduction of funds tied up in stockroom, insurance coverage, and lead time; and 4. Simplification of selection procedures by purchasing groups.

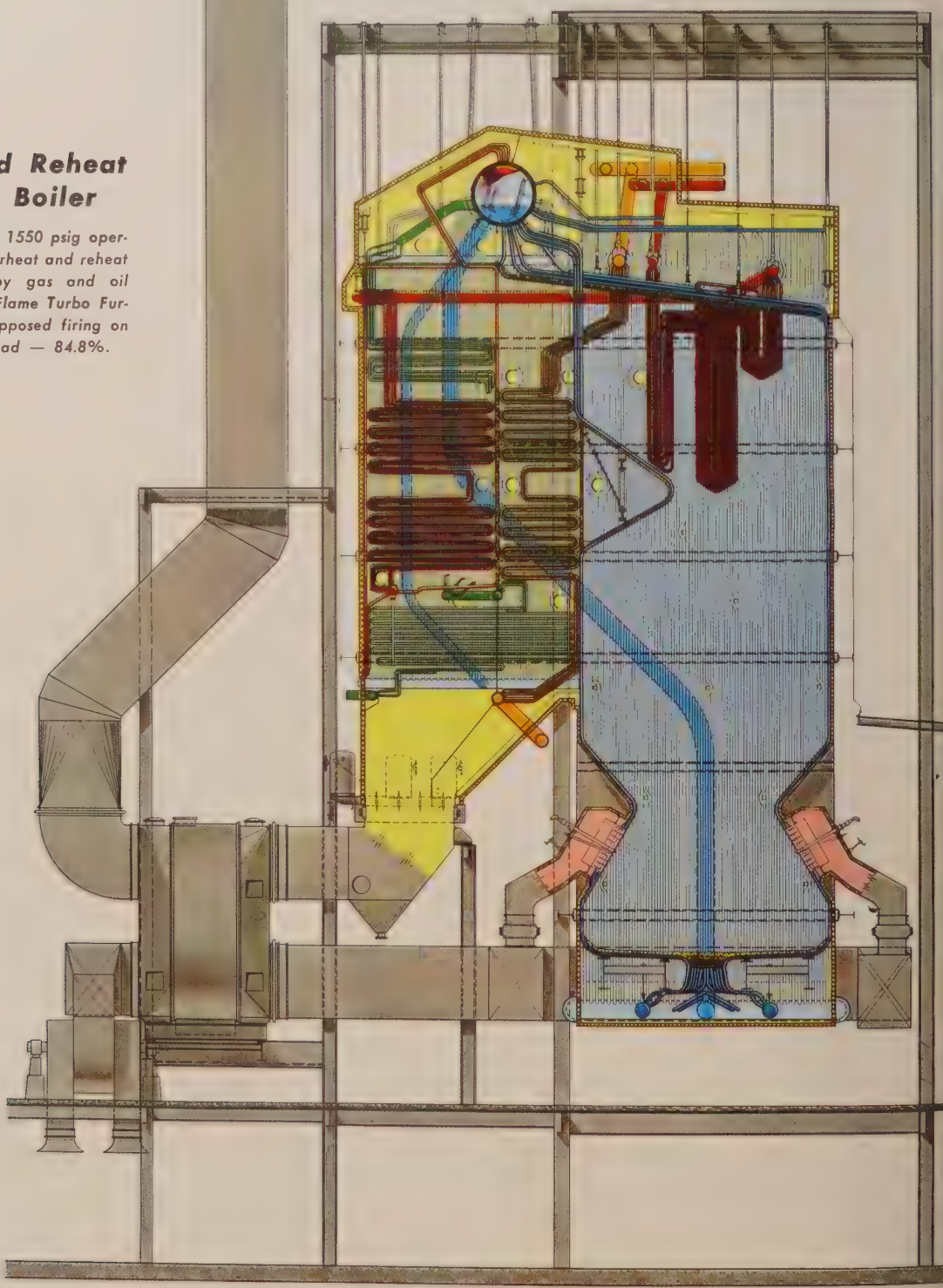
Reports of the various task forces concerned with standards and spe-

Located In the Great Permian Basin Area of West Texas

This Riley TURBO FURNACE Boiler can be converted quickly to coal

Riley Pressurized Reheat Turbo Furnace Boiler

Capacity — 825,000 lbs/hr at 1550 psig operating pressure and 1005F superheat and reheat steam temperatures. Fired by gas and oil through 12 Riley Directional Flame Turbo Furnace Burners positioned for opposed firing on one level. Efficiency at full load — 84.8%.



Ask your Riley representative for detailed information about Riley Turbo Furnace Boilers — or write direct to RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS.

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Burning gas and oil now, it may someday become both practical and economical for Texas Electric Service Company to fire its new Riley Turbo Furnace Boiler at Permian Basin Steam Electric Station, Monahans, Texas, with coal.

Because of the Turbo Furnace's unique multifuel characteristics this unit can be quickly and inexpensively converted to coal firing: combustion of coal, oil and gas produces substantially equal furnace performance with equivalent furnace exit temperatures simplifying steam temperature control changes; in addition the ability of the Turbo Furnace to stay clean and slag-free eliminates the need for slag-blowing equipment and sustains an efficient furnace performance indefinitely.

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cifications indicated that tomorrow's standards, where possible, will be predicated upon performance requirements rather than rigid design, material, or dimensional specifications.

Safety

The safety record of the utility industry is good, said H. E. Hatfield, Georgia, but not good enough. Most accidents occur on simple jobs that have little or no planning; usually no-one is looking, and rules are not followed. To improve the record, he suggested, the worker must be removed from any possible path to ground. He recommended use of insulated platforms or baskets, 18-in. rubber gloves, and complete covering of all energized lines and equipment in the work area. Work during rain, mist, or fog, he warned, must be avoided.

J. D. Hoag, St. Louis, reported excellent results from a revised safety program which lowered his company's accident frequency rate from double that of the industry average to one-half. A new accident reporting system coupled with an incentive plan, which provides a night out for each employee at company expense and small gift awards to supervisors, were said to have brought about the improvement.

Technical Education

Coordination of various departments in technical schools will ultimately lead to disappearance of departments as we know them today, and development of a more general product called a Bachelor of Science, predicted D. A. Fisher, dean of the Washington University engineering college. This is being brought about by several factors, he said, among them a pressure for more culture, less theory. Specialized higher education will have to come from graduate work or industry training programs, he suggested. He urged industry to help technical schools get the latest tools and to make sure that instructors know how to use them. This, he said, will speed up the acquisition of technical knowledge and provide the necessary time for electives which students do not now have.

General Engineering

The NCUR is very active, according to H. L. Davis, Jr., Philadelphia, trying to obtain additional radio channels for use of electric utilities and to insure continuous, reliable communications in the face of rules changes contemplated by FCC. Problem is also one of trying to retain channels already allocated, he said, because of requests of other industries. The telephone industry, for example, has asked for space channels between 1000 and 20,000 mc; these will have to come from those already allocated to others.

Interim standards to govern licensing of private microwave systems above 925 mc have been released by the Commission, continued Davis; while these will be effective January 1 for new equipment, they will not apply to existing equipment unless it interferes with stations operating in accordance with the standards.

A licensed radio operator is no longer required for power service transmitters operating above 25 mc, said Davis, if the operator is an employee of the licensee and designated as an operator. However, he suggested that utilities should establish a check system to make sure no one operates the equipment illegally. Early release of FCC rules to permit "tone signalling" on mobile frequencies was predicted by Davis; this will permit use of "coded tones" for switching operations.

W. D. Campbell, Central Power & Light Co., reported favorable experience with conversion of lengthy tabular output of load flow studies to a diagram print-out program. Diagrams are so much more convenient to analyze than tabular output data, he said, that his company now considers them to be an indispensable part of load flow studies.

A very comprehensive study of woodpecker damage to wood H-frame structures, presented by J. Umstead, West Penn Power Co., concluded that approximately one-third of a pole's cross sectional area can be lost before emergency measures are required. Problem, he said, is how to protect poles from further damage due to rot in the hole area. The study assured his company that its pole structures were not overdesigned.

Economic conductor sizing of primary distribution feeders is practical and promises worthwhile savings, according to F. F. Gray and A. W. Gebhardt, St. Louis, just as long as the practice is employed. Improved voltage regulation, increased ability to handle load diversions during emergencies, and reduction in the number of conductors and fittings carried in stock were among advantages noted by the authors.

Overhead Session

Work measurement is an effective tool for reducing costs, according to J. J. Misic, Cleveland. However, analysis and interpretation are essential or performance comparisons have no value, he said. Further, line supervisors must be fully indoctrinated in the reliability and uses of this tool. An adequate time reporting system is absolutely essential, he added, in order to determine the percentage of productive time.

Productivity studies of the line work forces in St. Louis serve three functions, according to C. E. Monfort, Jr., Union Electric. They measure performance of crews of various sizes, point out foremen who need coaching, and help evaluate benefits of new labor-saving devices. While records are published quarterly, he observed, these may be somewhat distorted by one poor job; fair comparisons must be made over an extended period, such as from annual reports.

The popular belief that small crews are most economical because they eliminate need for a non-producing foreman is not proving out on our system, said Monfort. The crew leader of a three-man crew is not fully productive and this is reflected in the high cost we have experienced with this size crew. Only benefit to be gained from three-man crews, he concluded, is relieving larger crews of the smaller jobs, thus reducing manhours lost during driving time and improving productivity of larger crews. Because of pole congestion, he said, manpower of a three-man crew is frequently not enough for even a small job.

Reporting more rapid progress on the tree-growing control project than anticipated, R. Hicock, Connecticut, said that several chemicals of 118 screened appear practical, and one, B-78, shows enough promise to warrant field tests.

ON THE SUBJECT OF STREET LIGHT PHOTO CONTROLS, A MILLION WORDS HAVE BEEN USED ABOUT A MILLION CLAIMS OF RELIABILITY. *BUT*...

FACT 1: The big killer of photo controls is transient voltage surges in secondaries

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FACT 3: Using Varistors in conjunction with a secondary lightning arrester, the new Lumatrol Mark I photo control withstands ALL transients up through the capabilities of the secondary arrester.

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IS TODAY THE
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ALL THE DESIRABLE
CHARACTERISTICS
YOU WANT AND NEED
IN AN AUTOMATIC
LIGHT SWITCH . . .
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Vennard, Harrison, Hamil Express Like Views,

Call for Greater Industry Cooperation At Electric Farm Power Conference

Enthusiasm for greater cooperation among the various groups working to advance farm electrification was general and genuine, sparked by the expressions of spokesmen for the industry agencies representing them, at the National Electric Farm Power Conference where attendance reached nearly 900 at the seventh annual session, held recently in Louisville, Ky.

Ralph J. Foreman, chairman of the Inter-Industry Council, reported on outstanding work of state councils, now numbering 28—all organized in the six years since the national program was launched in 1953. New reports were presented by council representatives from Michigan, Missouri, Ohio, Oklahoma and North Dakota. (In 1959, reports were made on successful council programs in Arkansas, Colorado, Illinois, Kansas, Kentucky and Virginia.)

EEI's Managing Director, Edwin Vennard, suggested that, among the cooperatives and the private utility companies, there are many areas of common interest which could be strengthened and expanded. He also acknowledged that there are areas of differences of ideological viewpoint.

He said: "Let us sit down together with the aim first to understand these differences and then to let us see how best we can work them out, in the interest of the farmer and the whole American economy. We would be short-sighted indeed and failing in our obligations and responsibilities to the American people if we permitted these differences to divide us and prevent us from working together for the most economical and efficient way of getting power to America's farms.

"Our primary common interest is in increased utilization and herein lies the value of the Inter-Industry Farm Electric Utilization Council." Mr. Vennard advised: "Let us expand the role of this agency. Let us reactivate it in the states where it is dormant. Let us expand it to all states where we have a common interest. Let us exchange ideas, one state with the other. Can we not work out more joint sales efforts, more jointly prepared literature going to the farmers, more joint promotional farm utilization efforts? Let us have regular meetings to exchange ideas on salesmanship and utilization. Let us have more joint meetings of our farm sales people."

NRECA's Pres. Walter Harrison called for understanding between the cooperatives and the utilities, for an appreciation of each other's position, for a desire to work on peaceful terms and under proper conditions. Until that is done, he said, the electric industry in America will continue to have turbulent conditions prevailing.

He observed: "It is not good for the industry, it is not good for America, that two of it's finest citizens, who can mean as much to the progress of the people as any other citizens group or groups, should be constantly sniping at each other, yapping about something, when we should recognize that both are first class citizens, worthy to sit at the first table and counsel together."

David A. Hamil, REA administrator, observed in his keynote address that consistent cooperation among all segments of the industry can be one of the best answers to the challenge of the electrifying sixties.

Mr. Hamil expressed a conviction that rural development can prove one of the most productive approaches to achieving "vertical coverage" among rural consumers. He said:

"Despite the improving standard of living in this country, there still remain a number of rural areas where income has not kept pace with that in other communities. These are areas of marginal farms, by and large, where there are few opportunities for off-the-farm occupations to supplement income.

"These areas face many problems, but more income could solve practically all of them. It takes income to improve housing, to build new schools and highways, to finance hospitals. It takes income to buy refrigerators and freezers and to pay bigger electric bills. Power suppliers in these low-income areas have a very real interest in helping their communities to attract more payrolls.

"I hope that all of you in such areas will assume responsibility and leadership in local rural development programs. You supply one of the essentials in attracting industry and processing plants to rural areas. Perhaps you understand your own local resources better than any other group of business people. When you go home, take a good look at these resources, and determine what you have to offer. Then form your committees and get to work selling the good points of your areas."

Medallion Home promotion, space-heating, dealer-power supplier cooperation and appliance service problems—these were some of the areas of timely concern to the Farm Power Conference delegates. Particular points raised by speakers covering these subjects follows:

C. V. Sorenson, vice-president of Indiana and Michigan Elect. Co., offered this caution concerning the Medallion Home promotion: "Today, with the Gold Medallion Home, we seem to be closer to the point of success in our efforts than at any time in the past. But, I wonder if in our enthusiasm, we are leading the customer to believe that because he gets a Gold Medallion, he is getting the ultimate not only in electric equipment, but in quality of home construction. This could "boomerang" if not watched carefully.

"In the Gold Medallion Home, we have electric living in its full sense. By means of a single sale, we can completely equip the home electrically and eliminate the need for any competitive fuel. It would be a tragedy if, through inferior home construction electric heat, around which our story is built, were to prove unsatisfactory. Here certainly is a problem for serious management and sales department study," Mr. Sorenson observed.

R. B. Moore, general manager, Lea County Electric Cooperative, Inc., Lovington, New Mexico, noted that expansion into virgin territory is rapidly becoming a thing of the past with the cooperative organization and with the investments needed, developing new territory is most usually very marginal. He asked:

"Would it not be better to sell more kilowatt-hours over an existing system with only some supplemental investment and in so doing render your patrons a service desired and needed and good for all concerned?"

The vice-president of NARDA (Nat. Appliance & Radio-TV Dealers Assoc.), Hardy Rickbeil, proposed that power suppliers who aren't sponsoring service schools for dealers should do so at least once or twice a year. Also, he suggested that power suppliers should "just once a year, invite in four to six key account dealers and have a down-to-earth, serious conference with them on how to sell and service better."

Water Study—*from page 69*

or executive branch responsibilities, within the present overall framework, there is still room for a great many improvements . . . and there is no reason to believe that existing agencies will not be able to accommodate themselves to carrying them out.

5. The problem of Federal-State water rights calls for broad objective inquiry, and for statesmanship of the highest calibre in its solution—which must be worked out promptly to permit needed developments by state and local agencies to proceed on a sound and legal basis.

6. Public agencies at the local, state and Federal level need to encourage careful judgments as to the justifiable use of lands subject to flooding . . . and Federal expenditure for flood control works in any major drainage basin might well be made contingent upon the state or states involved giving assurance that regulations will be enforced to prevent further unwise encroachments.

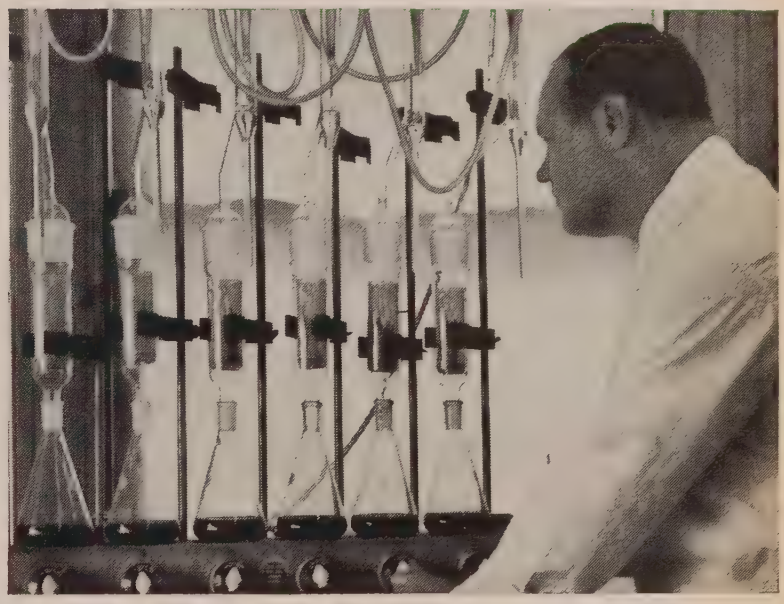
7. Economic incentives—especially in the fields of waste treatment, municipal and industrial use, and irrigation—would be most eflective in reducing demands on our water resources and making available supplies reach further.

Concluding his summary, Mr. Schad expresed the opinion that, "although much construction of water resource development projects will be needed in the West and the East, major improvements in water use technology are also necessary."

TECHNICAL BRIEF NO. 60-1

By D. L. DAVIES, *Manager, Technical Dept. Wood Preserving Div., Koppers Company, Inc.*

USE OF THE ASSAY METHOD TO DETERMINE RETENTION IN POLES



PRESENT STATUS

The Assay Method of determining preservative retention in pole charges has been described in Koppers Technical Bulletins W-101 and W-102. Following is the status of the Assay Method as a replacement for the less accurate gauge method of determining preservative retention.

The Western Electric Company, Inc. over 2 years ago made the Assay Method a part of its specifications on all new pole contracts. This major specification change was adopted to eliminate "weak sister" charges — charges which meet standard specifications by other measurement tools, but which in reality do not contain sufficient preservative to provide long-lasting protection.

The Rural Electrification Administration in April, 1960 issued new specifications which make mandatory that determination of retention in poles be made by the Assay Method. Many REA utilities have suffered financial loss from premature pole failures. They, too, want to eliminate the "weak sisters".

The Federal Government has a tentative specification TT-W-571f, now being reviewed by industry, which also calls for the Assay Method for determining retention (without alternates) in both poles and piles.

The AWPA adopted the Assay Method for determining retention in poles as a "full standard" at the April 24-26, 1960 meeting.

HOW TO APPLY THE ASSAY METHOD

In applying the Assay Method to poles, the specifications require that the outside ½" of the pole section be discarded. This section usually contains about 14-lb. preservative per cubic foot. Specifications further require that the next 1½" be assayed for retention. Therefore, an 8-lb. normal gauge retention charge must have a minimum of 6-lbs. per cubic foot in this zone. A 10-lb. treatment must have 7½ lbs. and a 12-lb. treatment must have 9-lb. in the assayed zone. No undertreatment allowance is permitted. Adoption of these retention requirements represents the most significant advance in standards for pine pole treatment since the adoption of 2½" or 85% sapwood penetration requirement in the late 1930's.

ANY COMPANY CAN ADOPT THE ASSAY METHOD

The status of the Assay Method for determining retention has advanced to the stage that any company can adopt it by a simple notation on the purchase order specifying that "poles are to be treated to a retention of x pounds/cubic foot as determined by assay".

• • • • • • • • • • •

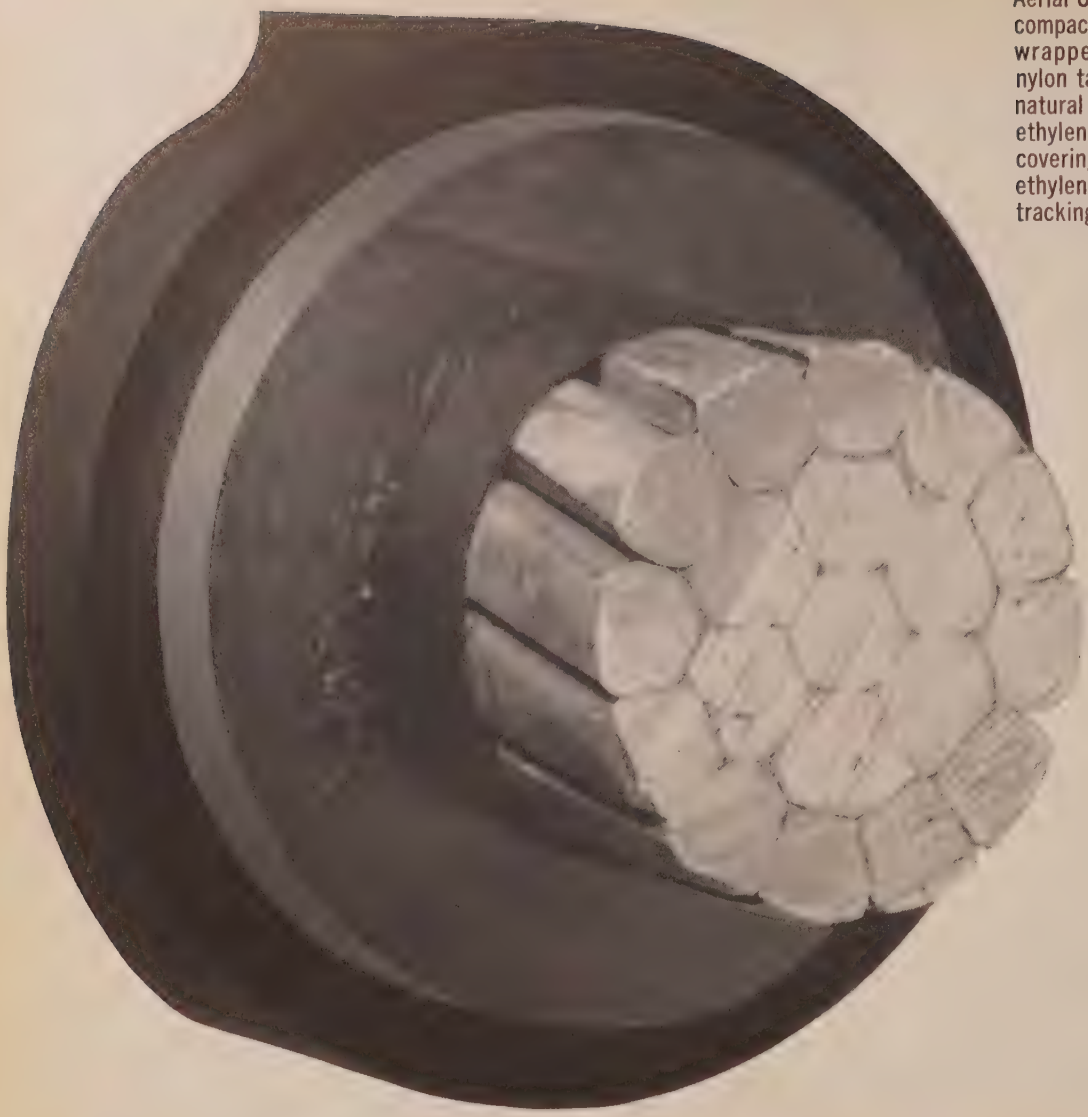
For the full report on using the Assay Method, or answers to technical questions on poles or pole treatment, write: Koppers Company, Inc., Wood Preserving Division, Technical Dept., Room 742 Koppers Building, Pittsburgh 19, Pa.

C-45

KOPPERS

KOPPERS

PRESSURE-TREATED WOOD



Magnified section of Hendrix 24 Kv Aerial Cable (336,400 CM 19-strand, compact-round aluminum EC-H19) wrapped with semi-conducting nylon tape and covered with .175" natural high-molecular weight polyethylene. To this is bonded a .125" covering of new high-density polyethylene that positively resists tracking.

NEW! A Cable Covering That Solves High-Voltage Tracking Problems

NEW HIGH-VOLTAGE HENDRI-CLAMPS

TRI-7 HENDRI-CLAMP
Easy to use. Self washing. Spaces conductors 7" apart. Will accommodate conductor sizes thru 1,000,000 CM, max. O.D. 1.5".

15 Kv VERTICAL HENDRI-CLAMP
Features inside weather washing. Minimizes ice accumulation. Easy to install Conductors are spaced approx. 6½" apart.

...and you get it only with Hendrix Aerial Cables

At last — a new polyethylene cable covering that prevents tracking at voltages above 9 Kv. Developed by Hendrix in cooperation with the technical service department of Union Carbide Plastics Co., Division of Union Carbide Corp., this remarkable new polymer covering has proved itself in exhaustive laboratory and field tests. Let us prove to you how this new covering ends the costly troubles that arise from tracking problems. Write us for free field demonstration.

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Cannot Compete With Foreign Labor Rates

Manufacturers Protest Lower Insulator Tariffs

"If insulator buyers follow trends established by one of the largest purchasers of foreign insulators in the U. S. (Bonneville Power Administration), the high voltage insulator industry in this country will be out of business," said Ralph Jenner, president of Lapp Insulator Co. to the U. S. Tariff Commission and the Committee for Reciprocity Information this last month in Washington.

Speaking for the entire high voltage insulator industry, Mr. Jenner registered strong protests to authorities against the proposed downward revision of existing tariff rates on insulators from abroad. He told the investigating bodies that "we have lost our business with foreign countries because of the lower labor costs in countries outside the United States. It is impossible to compete with foreign labor rates."

Mr. Jenner pointed out that all power generated and distributed in the United States is dependent on the insulator business; all transmission of electrical power requires porcelain insulators, and all industries require power to continue operation. "To permit foreign countries to take over our insulator market would be a tragedy in case of national emergency."

Since the insulator business is largely a handcraft and assembly type of manufacturing, the highest production costs is labor. As an example, he cited Lapp straight time earnings at $2.54 per hour, plus $0.64 an hour benefits, or a total of $3.18 per hour. "To compare this man hour cost to the Japanese's of 20¢ an hour is ridiculous," he declared.

Mr. Jenner stated that "it is impossible for us to compete on the basis of price in our own country." He reported figures from a March 1960 bidding to BPA. American companies bid between $318,063.62 to $320,343.62. The Japanese bid was $272,081.00—86 per cent of the lowest American bid. For a New York Power Authority quotation, bidding by the Japanese was be-

(Continued on next page)

Nuclear Fuel-Transport Heat Exchanger Developed

Specially designed nuclear system heat exchangers have been developed for shipment of spent nuclear fuel elements to reclamation plants. The heat exchangers, made by American Standard Industrial division, develop high efficiency.

During transport, which may be by flat car or ship, the spent elements continue to generate great quantities of heat within their lead-lined containers.

The nuclear transport heat exchanger system is made up of two closed circuits. The internal primary circuit removes heat from the water-filled container in which the fuel elements are submerged. Then the external secondary circuit removes the heat from the primary circuit, dissipating the heat in the air outside the container. The external circuit isolates the radiation-exposed fluid of the internal circuit from unshielded areas.

Three members of the Central Electricity Generating Board of London, hear T. W. Hissey, Jr. (right) explain how Leeds & Northrup Company's new transistorized computer will enable Australia to fully integrate its power resources for the first time. The analog device, now being readied for shipment, will provide operating economies in the power generating facilities serving more than half of Australia's population. The Englishmen, who saw the highly-advanced computer recently at once of L&N's plants are (l. to r.) U.G.K. Knight, J. A. Roberts and E. C. Scott. Hissey is in charge of the Electric Power Group of L&N's Market Development Division.

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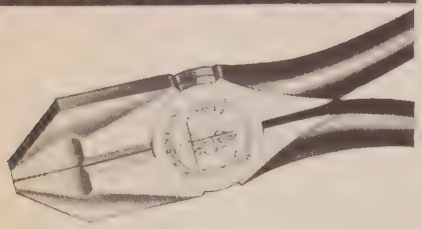
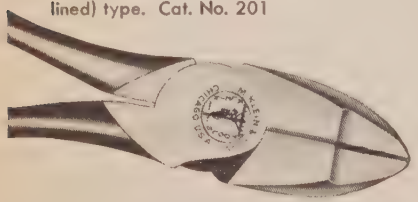
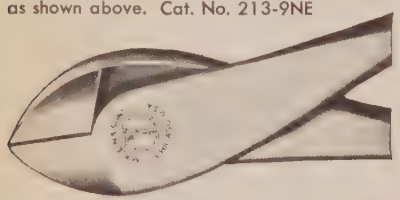
for LINEMEN and ELECTRICIANS



The Original Klein Side Cutting Plier—Also available in NE (Streamlined) type. Cat. No. 201



High Leverage Plier—Extra high leverage permits cutting extremely tough wire. Also available in the standard type as shown above. Cat. No. 213-9NE



High Leverage Oblique Cutting Plier—A recently introduced plier designed to cut toughest wire. Cat. No. 228-8

Electrician Conduit Plier—Reams inside and outside of conduit, tightens lock nuts in outlet boxes. Cat. No. 333-8

"Since 1857" the name Klein has stood for the finest in tools and equipment for linemen and electricians. It is the uncompromising high quality back of the name Klein that has won Klein Pliers their place in the hands of men who know good tools. Klein Pliers are now available in a wider variety of styles and sizes than ever before. Be sure the pliers you need carry the Klein trade-mark.

Klein Catalog Free—This new Klein catalog giving complete information on Klein tools and equipment for linemen and electricians will be sent on request. Write for your copy.

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MANUFACTURERS PROTEST . . .

(Continued from previous page)

tween 86 percent and 78 percent of the competing American firms.

Further, he said that foreign competition pricing is not based on cost but rather on an adjusted price to ascertain getting the order. He reported on quotations by a Japanese company for suspension insulators, delivered in Chile at $1.62 each. The same units delivered in Portland, Ore., were quoted at $3.08.

Mr. Jenner concluded by saying "We have subsidized foreign competition in several ways: by taxes which have helped to build foreign plants; by taxes which have gone into aid to countries that are purchasing foreign made over American insulators. Further concessions to foreign competition could deprive Americans of an industry that is tax paying, employs U. S. citizens, that uses domestic materials, and that serves a market which it supports and helped to create. The insulator industry is in jeopardy only because it pays the wages on which our standard of living in this country depends."

PICA Conference Held in St. Louis

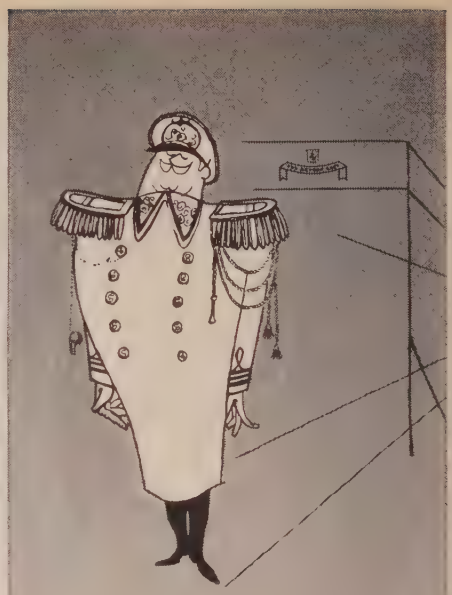
"Computers for Engineering and Power" was the meeting theme of the second Power Industry Computer Application Conference held in St. Louis November 9-11.

Latest developments in digital computers for utility engineering and plant automation were presented in 25 papers presented by authors from operating utilities, manufacturers, and research organizations.

The conference was sponsored by the Power division and Computing Devices Committee of AIEE.

General sessions of the conference were devoted to Power System Analysis by Digital Computer, Computers for System Operation and Optimizing, Computers for System Planning, and Automation and Data Gathering—Computer Control.

In addition, general presentations covered characteristics of available computer systems and programming techniques, and an outline for the interchange of computer programs, arrangements for computer services, and visits to two large computer centers.



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Naturally, every room has individually controlled air conditioning, color television, FM radio, extension phone in bathroom, its own private cocktail bar. And may I venture to say, sir, the personalized service is unparalleled.

Welcome, sir—and madame—to

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Several executive suites suitable for large companies as a year round city apartment.

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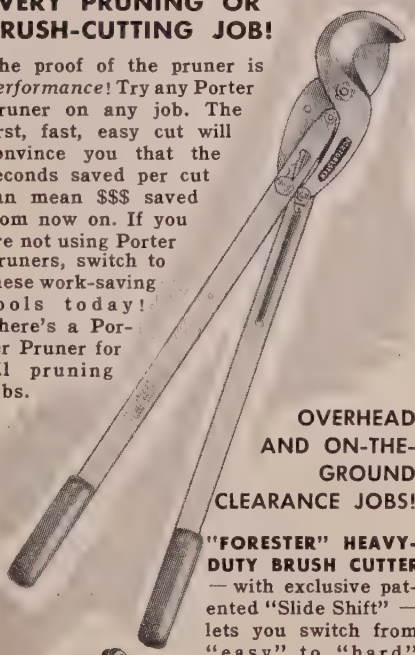
FASTER, EASIER CLEANER
Pruning

A FINER TOOL FOR EVERY PRUNING OR BRUSH-CUTTING JOB!

The proof of the pruner is *performance*! Try any Porter Pruner on any job. The first, fast, easy cut will convince you that the seconds saved per cut can mean $$$ saved from now on. If you are not using Porter Pruners, switch to these work-saving tools today! There's a Porter Pruner for all pruning jobs.



OVERHEAD AND ON-THE-GROUND CLEARANCE JOBS!

"FORESTER" HEAVY-DUTY BRUSH CUTTER — with exclusive patented "Slide Shift" — lets you switch from "easy" to "hard" to "toughest" cutting simply by shifting the handle. Takes the place of 3 ordinary pruners. 2 sharp, fine-steel blades give quick-healing, clean cuts, make work easy for operator. 2 models — 0290F — Capacity 1½" green wood; 0390F — Capacity 2" green wood.

PORTER POLE PRUNERS for utility line clearance. 4 models — for all work. Lightweight model — short and long arm types, with and without pulleys. Cut up to 1" green wood. Available with Solid or Jointed Poles.

ASK YOUR SUPPLIER — or write us for the complete PORTER PRUNER catalog.

HKP® H. K. PORTER, INC.
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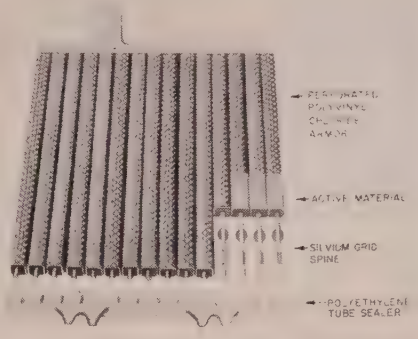
Capacity of Batteries Upped 66 Per Cent

A positive-plate design that is unique in application has boosted electrical power of industrial storage batteries for stationary service by more than 66 percent.



Drawing shows cutaway of new cell design.

Designated the EHGS, the battery employs a tubular-type plate that far surpasses the capacities of other type batteries used in utility and emergency lighting and power applications, according to the manufacturer, Exide Industrial division of the Electric Storage Battery Co.

Costs per ampere-hour per year are reduced due to the excess power capacity and an estimated life of 20 years in float-charge service. In addition, it can save up to 64 percent of floor and mounting-rack area and up to 55 percent in weight.

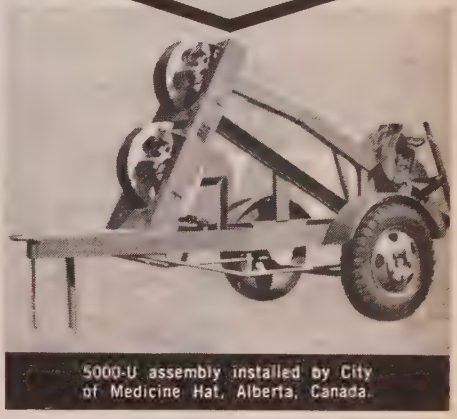
Octagonal Pole Passes Tests

A tapered octagonal aluminum pole, 85 ft long with a 2-ft base width, has demonstrated the ability to withstand hurricane forces during recent tests. The octagonal pole, like the Alrectic lattice pole (EL&P, April 1, 1960, p 71), was designed for use on a 110-kv transmission line with an average span of 600 ft.

The pole, with three seven-ft crossarms, weighs about 2400 lbs, some 30 percent of the weight of a steel pole of the same height. The pole is tapered and the strength is strategically distributed by using two sizes of chord extrusions with stiffener plates welded inside opposing chords to give directional strength in the transverse loading direction.

Wind loadings to the horizontally tested pole were equivalent to gales of approximately 140 mph, 12 percent higher than NEMA standards.

Now—Convert your own Reel Dolly to a Bullwheel Tensioner WITH A PENGO 5000-U Assembly



5000-U assembly installed by City of Medicine Hat, Alberta, Canada.

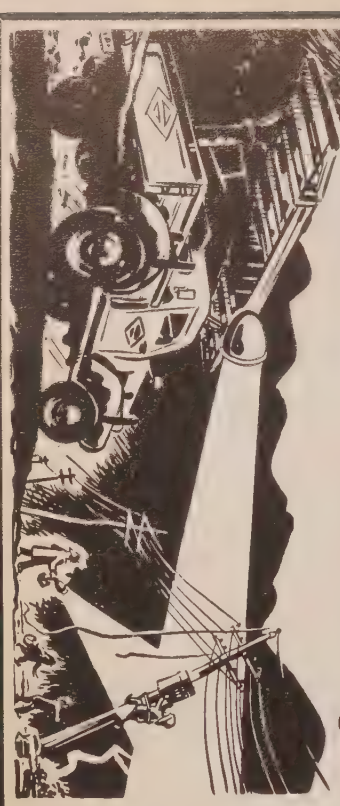
Here's an easy way to build up a modern bullwheel tensioner at low cost—simply install a PENGO 5000-U Bullwheel Assembly to your old trailer or reel dolly. You'll have a tensioner with Neoprene-lined 26" bullwheels, capable of handling practically any distribution line stringing job at tensions to 2,000 lbs. at up to 4 mph.

Support arms, reel spindle with reel brake, and hand rewind assembly. 2⅝" spindle will handle reels to 75" diameter, 44" width unless reduced to fit your trailer.

Bullwheel and tension brake assembly may be purchased separately.

We invite you to write or wire for literature, prices—please address Dept. 28

PETERSEN ENGINEERING COMPANY, INC.
Santa Clara, California
Phone: AXminster 6-7712



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DONNA CAME—AND—DONNA WENT!!

and hundreds of "Ray-Line" Portable Searchlights helped restore service quickly.

There IS a reason why Utility Companies standardize on "RAY-LINE" PORTABLE SEARCHLIGHTS for EMERGENCY Night Work.

Let us tell you so YOUR Crews can have the best when Winter Storms come!!

Send coupon for information and free trial offer. No. 26

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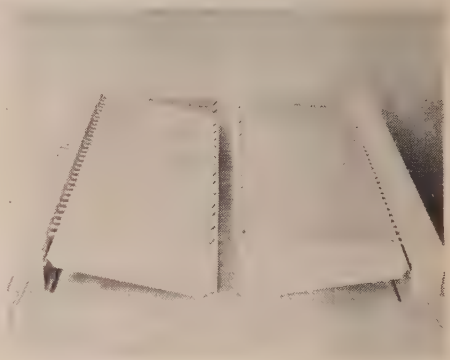
THE PORTABLE LIGHT CO., Inc.

65 PASSAIC AVENUE • KEARNY, N. J.

NEW PRODUCT DESIGN

Electric Heat Solves Hopper Car Unloading During Winter

The long time need for a device for quickly and economically removing ice, snow, and frozen residual material from railway hopper cars before unloading can be met with a specially designed electric radiant heater by **Radcor, Inc.** The heaters, used in pairs, are placed between the rails so as to be directly below the cars. Each unit, designated RUC-32, has a maximum capacity of 32 kw, 240 v, three-phase, and contains 16 alloy-sheath Chromalox heating elements having thread-end, waterproof fittings. Units are 44 in. long and 22 in. wide. Manufacturer claims that



a car bottom can be cleared of snow, ice and residual material in a matter of minutes. Available from **Edwin L. Wiegand Co.**

Circle item #30 on reply card

Construction, Line Truck

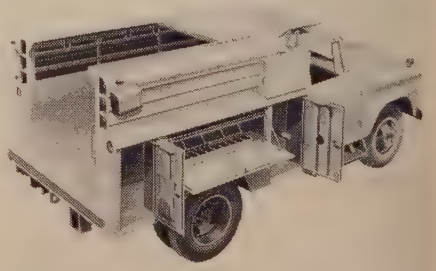
McCabe-Powers Body Co. has announced its 1960 version of the series 400 Line Construction and Maintenance Body. Standard equipment includes all shelves and parts bins, material hooks in forward compartments and cargo area, pike pole carrier, extended winch shaft opening in curbside front door, and slam-action latches. Body is designed for installation on chassis having dual rear wheels and cab-to-axle dimension of approximately 60 in.

Circle item #32 on reply card

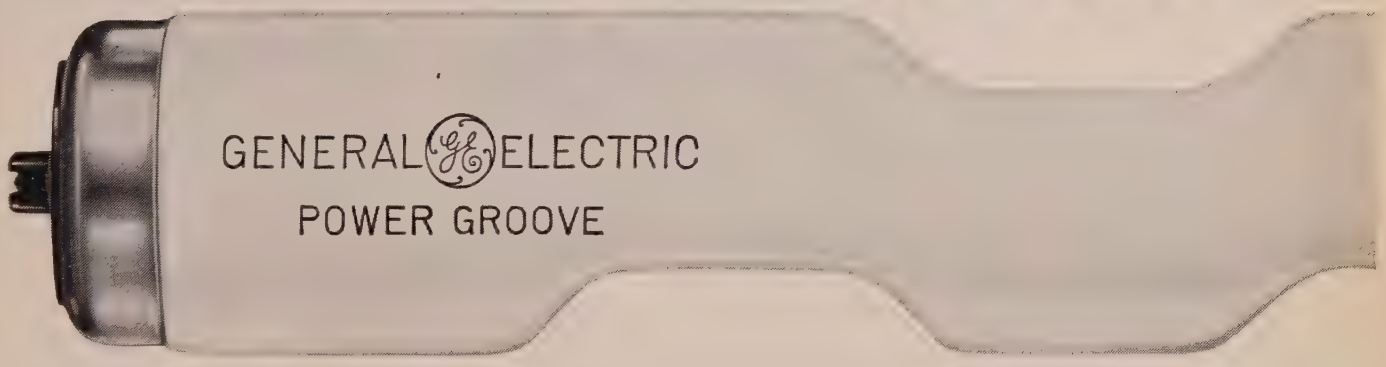
Aerial Pulley Block

Faster and more economical installation of power distribution cables is possible with Tri-Pulley Stringing Blocks, according to the **Hendrix Wire & Cable Corp.** Lighter than earlier aluminum models, the Hendrix unit utilizes pulleys molded of Plaskon Nylon. In addition to reducing breakage, choice of self-lubricating Plaskon Nylon for the unit's pulley is said to further reduce maintenance time and cost for the Hendrix unit.

Circle item #31 on reply card



CUT INITIAL COST AS MUCH AS 40¢ PER SQ FT



It's easy with the most powerful fluorescent on the market! If you're planning a new building . . . or remodeling an existing one . . . you can shave your customer's initial lighting investment by as much as 40¢ a square foot!

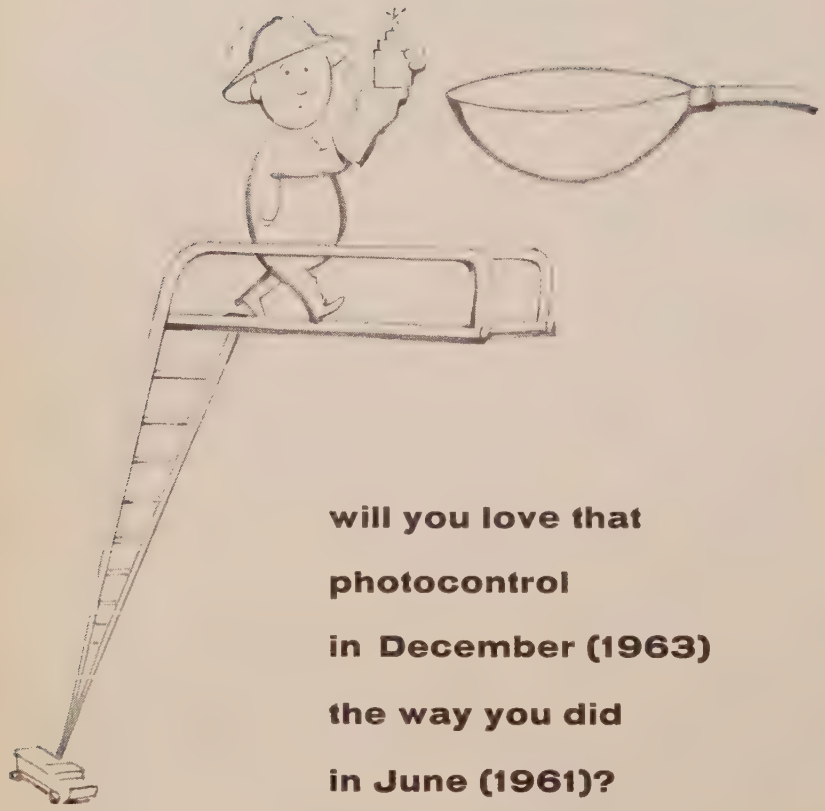
How? Specify G-E Power Groove* Lamps. They give more light than any other lamp. You use fewer lamps, fewer fixtures, fewer everything else it takes to light your customer's building properly. And his savings keep mounting. With fewer lamps, fixtures and ballasts, his maintenance bills will be lower, too.

The secret's in the grooves. They're what bend the arc stream (it's straight in other fluorescents) . . . lengthen it . . . make the lamp put out more light. Only G-E Power Groove Lamps have 'em. Only General Electric gives you this years-ahead light source—another example of a difference that makes a difference in value to you. Call your G-E Lamp distributor for more information. General Electric Company, Large Lamp Dept. C-031, Nela Park, Cleveland 12, O.

*General Electric's trademark for configurated fluorescent lamps

Progress Is Our Most Important Product

GENERAL ELECTRIC



will you love that photocontrol in December (1963) the way you did in June (1961)?

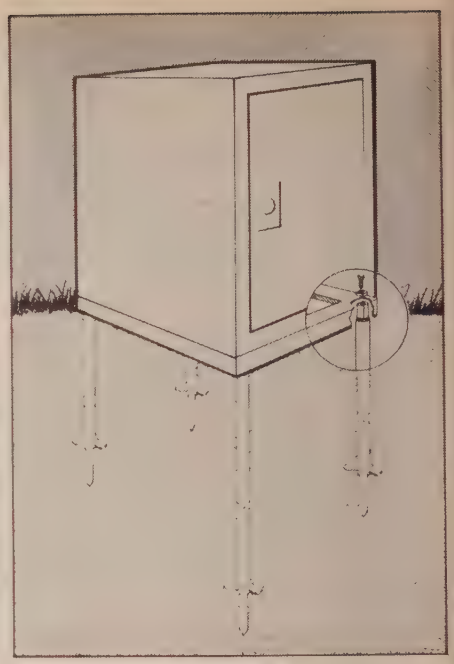
Getting stung with 30,000 "inexpensive" photocontrols that all start failing off three years after installation is no joke, as you can imagine. What kind of *people* make and sell the controls you plan to buy — and are you getting the straight story from them? The Fisher-Pierce Co., 81 Pearl St., So. Braintree 85, Mass.

FP

FISHER PIERCE

Electrical and Electronic Equipment for Industry, Utilities and the Home

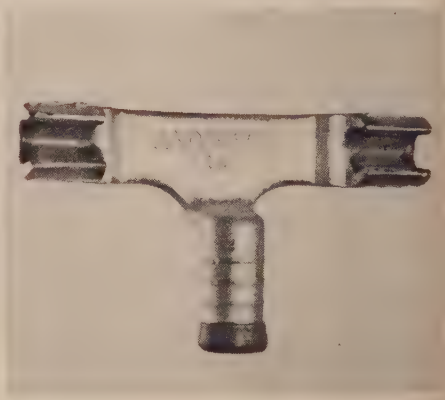
AN AFFILIATE OF SIGMA INSTRUMENTS, INC.



Foundation Anchor

The **A. B. Chance Co.** has designed an anchor that takes the place of concrete pads when mounting distribution transformers in sub-divisions. The foundation anchor is installed vertically to support the transformer. Four anchors are installed by two men using a special hand wrench. Complete installation, from start to energized lines, takes less than a day.

Circle item #33 on reply card



Tee Tap Connector

An easy to install compression tee type connector, Type DCT, is available from **Anderson Electric Corp.** The cable to cable connector can be compressed with the same die that is used to compress the main. In addition, for hot line work there is a side open main. One advantage of the connector is the wide separation of tap and main, which provides for maximum protection in making bi-metallic joints.

Circle item #34 on reply card

THE CONNECTING LINK

The SALES REPRESENTATIVE serves as a connecting link between the PURCHASER and the MANUFACTURER. The qualified rep is well informed concerning the customer's requirements and thoroughly familiar with the manufacturer's products. The rep's function of properly fitting together needs and products benefits all concerned.

The PURCHASER gains product application, quotation and expediting service. Also just and forthright handling of adjustments.

The MANUFACTURER gains a capable and efficient marketing organization at a predetermined low sales cost. The numerous contacts of each rep's sales personnel are especially valuable.

ELECTRICAL EQUIPMENT REPRESENTATIVES ASSOCIATION, founded in 1948, is dedicated to BETTER SELLING and SERVICE. Its members are ambitious to improve their performances and to benefit by the interchange of experiences and ideas with others in the same line of work.

Send for EERA Directory, listing the members, accounts handled and territories covered. It's free.

EERA, 1675 Fifth St., Clermont, Fla.

EERA

Magnetic Demand Meters

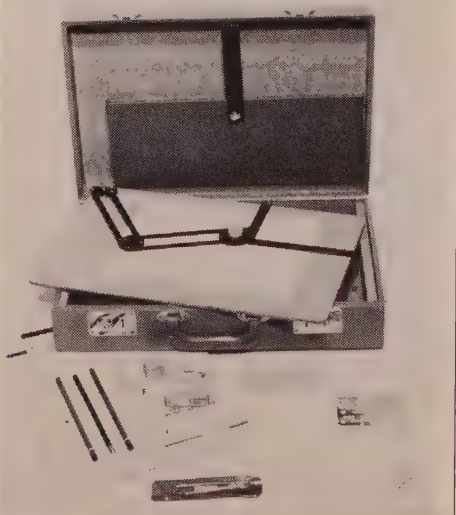
Following introduction of the J3 kwh meter with magnetic flotation, **Sangamo** has rapidly extended the principle to its complete line of single and polyphase meters. Now introduced are combination kwh-Lincoln kw demand meters. J3T incorporates the J3 with a single-phase watt demand meter. PW polyphase kwh-Lincoln kw demand meter now has the P20 kwh element with magnetic flotation. Scheduled for Jan., 1961, production.

Circle item #35 on reply card

Portable Drafting Kit

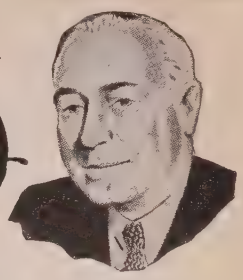
Draftette portable instrument combines advantages of drawing board T-square, triangle, and protractor in sturdy vinyl covered attache case. Manufactured by **Retake, Inc.**, the kit makes it possible to have everything on hand necessary to getting creative ideas down on paper. Easy to carry about, the case also serves as a base for the drawing board, raising the board to a better working level. Kit has 14 pieces in total.

Circle item #36 on reply card



*Trademark

Fine Fanner Superformed Products



"Superforms* make my Budget Dollars go farther" ... PURCHASING AGENT

"We have to look at budgets as investments . . . in terms of *return* . . . all the way from negotiating and pricing, to having equipment available when needed for use.

"With Fanner Superforms, we get *prompt quotations* from the Agent and the Factory . . . they *meet their commitments* . . . give *reliable service.*"

These are reasons why more and more Purchasing Agents are buying more and more Superforms. A-1595A

FANNER Superformed with a "PROTECTIVE TWIST"

ARMOR RODS ... Protect long-span T&D lines at supports

LINEGUARDS ... Protect short-span T&D lines at supports

PATCH RODS ... Repair damaged conductors

TAP ARMOR ... Protects conductor at tapping points

FANNGRIPS ... For dead-ending strands and conductors

FANNSPLICES ... Join two ends of conductor wire

PLASTIC PRODUCTS ... For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

VIBRATION PROBLEMS PLAGUE RURAL LINES

(Continued from page 83)

even more unusual. Except for highly-tensioned river crossings, damage rarely occurs on large-diameter cables protected by armor rods and supported in well-proportioned suspension clamps. However, on this economically-constructed line, serious difficulties were encountered almost from the start.

Construction details are as follows:

Conductor: 900,000 CM 54/7 ACSR (ultimate strength = 32,300 lbs).

Ruling Span: 1400 ft.

Final Unloaded Design Tension: 26.8% of ultimate strength at 60 F.

Structures: Single-circuit steel towers.

Armor Rods: Wrench-formed, tapered.

Dampers: Stockbridge.

Date of Energization: January, 1958.

Terrain: Two types, level and hilly.

Approximately 13 months after the line was energized, one of the towers collapsed in the section of line which crosses flat-to-undulating open country. This failure was attributed to excessive tower vibration causing a shifting of the sandy soil supporting the foundation of the structure. Following this failure, all tower footings were reinforced and a close inspection of the line was made by utility personnel. Abrasive damage to the conductor beneath armor rods and their end fittings was evident from the presence of black aluminum oxide that had filtered to the outer surfaces. At a few locations, the end fittings had vibrated free of the armor-rod ends and had moved out onto the conductor. Disassembly of selected armored supports revealed that conductor fatigue breakage had occurred beneath the clamps, but the most serious damage was found under the armor-rod ends as shown in Figs. 6 and 7.

A few months after construction, Stockbridge dampers had been installed on selected spans in an effort to curb the excessive vibration observed on the line. During the field inspection, one damper was found to have loosened and moved about two feet from its original position, abrading the conductor in the process. During a short period of low temperature (about 29F), serious vibration caused the weights to drop off of 43 Stockbridge dampers.

Some months after the initial tower failure, several more towers collapsed under the onslaught of transverse winds with speeds considerably in excess of the design wind loading. These failures were attributed to the debilitating effects of the vibration which the structures and foundations had previously experienced.

The major portion of damage on this line occurred in the section that followed level terrain. Little trouble to date has been experienced on the section extending through hilly country.

Since the line design was predicated on attaining economy through the use of high tension and minimum sag, the combination of ground clearance requirements and long spans made it impossible to obtain significant tension relief by re-sagging. Therefore, other methods of restoring the line to a serviceable condition had to be undertaken. Remedial measures consisted almost entirely of repairing the conductor fatigue and abrasion. PREFORMED armor rods of conventional design were used where only the outer layer of the conductor had been damaged. However, in order to restore mechanical and electrical continuity to the disabled aluminum elements, these rods were made long enough to extend approximately 24" past the abraded areas. Where it was known that damage to the inner layers had occurred, helical-rod armor-splices were employed. They, too, were of extra length.

EISLER TRANSFORMERS

IMPULSE TESTED

Eisler transformers are dependable. Made in sizes up to 3500 KVA. "Freedomland" power supplied by Eisler transformers. Eisler has facilities and capability of producing and testing the highest rated units.

OIL FILLED

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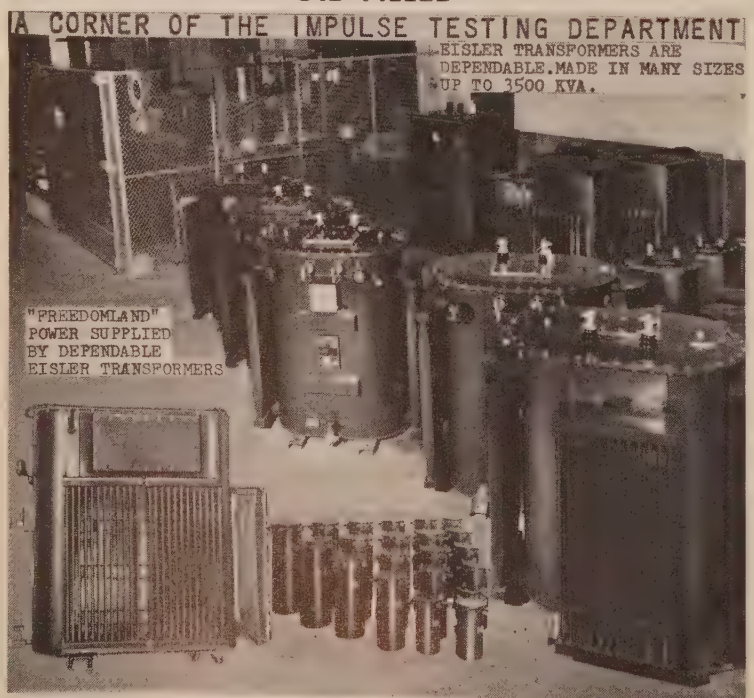

ASKERAL & DRY TYPE

EISLER TRANSFORMER COMPANY, INC., 20 NORTH SALEM ST., DOVER, N. J.

Universal Ground Anchors

Were created knowing that a device should be developed which would provide satisfactory ground anchoring facilities in all types of soil.

This Ground Anchor is the result and can be used in practically any soil. It may be quickly and easily installed and is very efficient. Send for Brochure.

Send $1.59 for sample 2" Anchor complete with wire.

BROCHURE MAILED ON REQUEST

Write for complete No. 40 catalog

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3047 E. Grand Blvd. Detroit 2, Mich.

DRAW YOUR OWN CONCLUSIONS

about the savings possible with this new, standard control cable from Rome

How many ways might a control cable save you money in your generating and substation?

First, by being *versatile*. And Rome's new standard control cables (designated as the CT line) are just that. You can use them with AC or DC circuits, at voltages to 600 (Type B), or 1000 (Type C), all in accordance with new IPCEA-NEMA standards. You pick the number of conductors you need, from 2 to 37, in No. 10 or No. 12 AWG copper. You install new CT in open air, in ducts, or conduit, in tray or trough. Or bury them directly in the earth.

Second, a control cable must *perform well*, under a variety of conditions, over a long period of time. CT cables will. Each conductor is insulated with polyethylene, so you can be sure that its dielectric performance is excellent, particularly where moisture might be a problem. This insulation also stands up to acids, alkalies and oils. Then there's the Synthinol (polyvinylchloride) jacketing over *each* insulated conductor and over the *entire* cable. It gives added resistance to heat and chemicals, and provides good mechanical protection for the insulation as well as a flame-retardant barrier.

Third, consider *installation*. CT cables are flexible, clean, lightweight and fully color coded. They are also *smaller* in over-all size than rubber-insulated cables. You can use smaller conduit and fittings, or put more conductors in existing conduit. And, color coding makes for quick, correct connections and facilitates subsequent testing and maintenance.

Get all the facts and figures—including details on which sizes are available "off the shelf!"—about Rome's new CT cable. Write now for complete specifications. Address inquiries to Rome Cable Division of Alcoa, Dept. EL-100, Rome, New York.

Special requirements? As a cable specialist, Rome can answer any of your control cable problems not met by this standard construction. Ask your Alcoa-Rome salesman for details.

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CEDAR POLES

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Light in weight and clean. PENTAchlorophenol treated in our modern plant for protection against decay, moisture and insect damage.

TWO strategically located yards:
MINNEAPOLIS, MINNESOTA
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R. G. HALEY & CO.
SPITZER BLDG.
TOLEDO 4, OHIO

. . . TO THE EDITOR

Dear Mr. Garrett:

The article on Evaluation of Distribution Transformer Losses by Mr. Kenneth W. Klein in the July 15th issue of ELECTRIC LIGHT AND POWER is a most interesting study of the effect of varying the loss ratio in a transformer and deserves our appreciation. It is an elaboration of the method of evaluation developed by the Monongahela Power Co. in 1936 and includes several factors not included at that time. There are two essential differences in that Mr. Klein deals solely with the annual cost over a period of ten years while the Monongahela Power Co. considered the capital investment to purchase the transformer and finance losses over a period of thirty years.

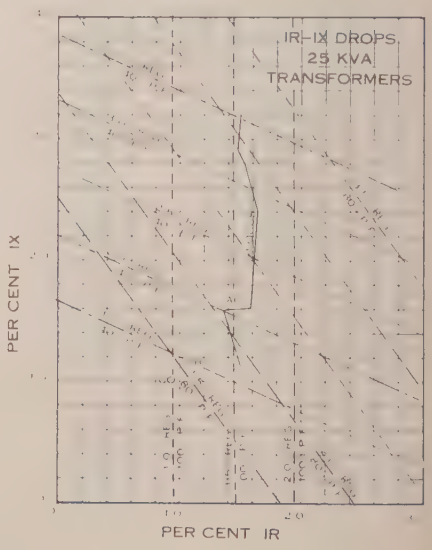
Transformers are rarely scrapped as early as ten years but are moved to a new location under lighter load. Unless they are damaged by overload or accident they will be in service for thirty years. By adding to the initial cost an amount which will finance the losses throughout its life, a true picture of the cost of the transformer is obtained. This can be reflected in the author's method by assuming that the transformer will go through three of his ten year cycles. This will treble the differences shown in the article.

The question of a diversity between system peak and transformer peak may not be an easy one to solve and may be a refinement which could be discarded. It adds only 88cts to the annual differential between A and B.

While it is correct to state that peak copper losses vary with the square of the load, it is not correct to assume that the loss factor of the transformer is the square of the load factor or that the loss factor will remain constant with changes of load. With the load increasing 8% throughout the cycle chosen, the loss factor will increase 3%. With a 40% load factor the loss factor may vary from 16% to 40% depending upon the form of the curve. Errors in assumption of constant loss factor may cause greater errors than savings indicated. However, the effort to evaluate changing conditions deserves more commendation than these comments may indicate.

The increase in revenue expected from decreased regulation of 1.6% on 30% of the load seems conservative. However the principle gain from reduced regulation is in the elimination of flicker in illumination and it deserves more consideration than can be reflected in the increased revenue. Decreased regulation can eliminate changes to larger size transformers to reduce flicker thereby saving cost of transformer changes, increased investment, and increased core loss. (See "The Line," March, April, 1941.) Due to the difficulty of evaluating such savings the method of limiting IX and IR drops suggested in that article has much to recommend it.

Attention must be directed to an error in the statement of the formula for evaluation of regulation. Either the increase in KW hr consumption or percent regulation must be expressed as a decimal. Use of the formula as stated gives results 100 times the actual figures tabulated.



Some question may be raised concerning the values of regulation assumed. The higher core losses of transformers B and C would indicate a higher flux density in the core. This in turn would lead one to expect a higher leakage reactance. The regulations assumed give IX values of 1.67%, 1.15%, and 1% respectively. This would indicate some rearrangement of coils to reduce reactance. Such rearrangement applied to transformer A

would have reduced its regulation and placed it in a more favorable light. The accompanying curve is taken from a group published in 1941, giving IR and IX characteristics of transformers then available with lines showing regulation at 40%, 80%, and 100% PF. Transformers A, B, and C have been located on the curve. From this it is evident that had the reactance of transformer A been reduced to that of transformer B, its regulation would have dropped from 2.2% to 1.88% at 80% PF materially reducing the annual cost assigned to it for regulation. Conversely, had the reactance of transformer B been held at the 1.67% of transformer A, its regulation would have been 1.91 at 80% PF thereby increasing its annual cost due to regulation.

The value assigned to reduced regulation has so much bearing on the resulting costs that the most favorable ratios of IR and IX should be used. The leakage reactance is apparently somewhat flexible even with a given core and copper. The regulation at 80% PF is dependent almost as much on reactance as on resistance and may not depend too much on the ratio of losses.

It is also suggested that worthwhile information might be obtained from two similar groups of transformer installations, one where no change is made in the voltage and the other where a slight increase is made in secondary voltage. This would be of more value than a simple assumption.

In 1941, I made the statement "We may expect to see more changes toward higher core loss, lower copper loss, lower reactance and lower resistance without any increase in the cost of the transformer and without sacrificing any of the admirable qualities of transformers which have heretofore been produced." Increased labor and material costs have masked the price situation but the continuation of studies such as this of Mr. Klein will always assist the manufacturer to product the most economical transformer at the lowest price.

H. A. Holmes
Consulting Electrical and Mechanical Engineer
Prescott, Arizona

Dear Mr. Garrett:

I was particularly delighted by Mr. Holmes' comments on the "Evaluation of Distribution Transformer Losses." I feel the purpose of the paper has been fulfilled when men of this caliber will analyze this subject as critically as Mr. Holmes has.

There are several points . . . on which I would like to comment:

1. The period of ten years was chosen only for convenience. In our calculations we use a 30 Year Life. However, this will not treble the cost differences since we are applying a present worth factor.
2. It was not intended to suggest that the loss factor was the load factor squared. On Page 60 of the July 15 issue in which the article appeared, we showed that Figure 4 is the square of Figure 3. Thus, the loss factor may be obtained by taking the daily load curve and squaring each point on the curve. It is agreed that the load shape is extremely revelant to the loss factor.
3. In the formula for Percent Regulation, regulation must be expressed as a decimal.
4. In choosing the designs B and C, several manufacturers were contacted and the values used were taken from their estimates for these designs. I do not know whether radical design changes are necessary, but I judge not since similar units are available on the market today.

It is impossible to overestimate the value of such men as Mr. Holmes and any others in the field that have analyzed transformer costs. Our purpose in writing the article was to stimulate people into studying their own transformer costs and policies. If this is done, I have no doubt that they will not all agree 100% with my methods. But it will stimulate them to approach the subject and, thereby, we will all profit by being better informed. Cooperatively, we will gain by ultimately getting transformers more closely designed to our modern growing system.

Kenneth W. Klein
Distribution Engineer
Cleveland Electric Illuminating Co.

*Trademark

Fine Fanner Superformed Products

"Superforms* are packaged for storeroom convenience"
...SUPERVISOR OF STORES

"The Fanner people understand our store-room problems.

"Their Superformed products are packaged right . . . well identified . . . easy to handle and store . . . don't get mixed up . . . are well catalogued . . .; and, they arrive on time."

The thousands of items that must be stocked, and *readily available*, present a tough problem for Store Room Supervisors. Fanner recognizes this, and *cooperates!*

A-1592A

FANNER Superformed with a "PROTECTIVE TWIST"

ARMOR RODS...
Protect long-span T&D lines at supports

LINEGUARDS...
Protect short-span T&D lines at supports

PATCH RODS...
Repair damaged conductors

TAP ARMOR...
Protects conductor at tapping points

FANNGRIPS...
For dead-ending strands and conductors

FANNSPLICES...
Join two ends of conductor wire

PLASTIC PRODUCTS...
For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

MEN OF POWER

Florida Power Names Bunnell, Perez

M. F. Bunnell

A. P. Perez

Election of two vice presidents has been announced by Florida Power Corp. M. F. Bunnell was named vice president in charge of industrial relations and A. P. Perez was appointed vice president in charge of operations.

A 34-year veteran with the company, Mr. Bunnell served as director of personnel for a number of years. He was made manager of industrial relations in 1957.

Mr. Perez has been in charge of the company's electrical department and is a registered professional engineer in both Florida and Georgia.

Newly-elected president of the Illuminating Engineering Society is Richard G. Slauer, manager of engineering for Sylvania Electric Products Inc., Wheeling, W. Va.

Boston Edison Announces Promotion

Election of Thomas J. Galligan as executive vice president of the Boston Edison Co. has been announced by Charles F. Avila, president of the utility.

A vice president since 1958, Mr. Galligan came to Boston Edison in 1953 from Lybrand, Ross Brothers, and Montgomery, where he was a certified public accountant. He joined the Boston utility as director of stores and services and was appointed assistant to the president in 1957. He was elected to the board of directors of the company last February.

Stone & Webster Service Elects Two Vice Presidents

Charles A. Ashby, Jr. and George C. King have been elected vice presidents of Stone & Webster Service Corporation, according to P. J. Rempe, president.

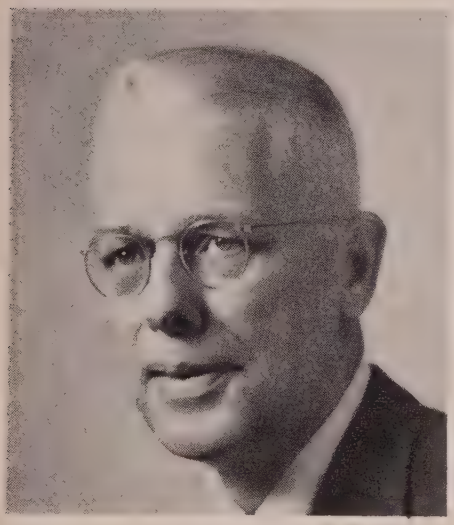
Mr. Ashby has been head of the firm's rate department since 1945 and has testified as an expert witness, on behalf of utility clients, before regulatory commissions in several states and Canada and before the Federal Power Commission. He first joined Stone & Webster in 1926 in the company's Boston office, and shortly thereafter went to Blackstone Valley Gas and Electric Company as a rate engineer and power sales representative.

Mr. King has been a sales consultant for the Service Corporation since 1954, having previously served as sales manager for Boston Edison Company, Brockton Edison Company and El Paso Electric Company.

Elevate Carlson

Carl O. Carlson, former executive vice president of Atlantic City Electric Co. has been promoted to the post of assistant chairman of the board of directors of the company. He was also elected to membership on the board.

Mr. Carlson was elected executive vice president in June, 1959, after serving as a vice president of the



C. O. Carlson

company since 1952. He was named senior vice president in 1957.

He joined the company in 1926 as a distribution engineer and was named superintendent of electric operations in 1948. He held that post until his election to the post of vice president of electric operations in 1952.

New GM For Gulf Power

Robert L. Pulley, who has served as vice president and operating manager of Gulf Power Co. since 1951, has been appointed general manager. At the same time, Robert F. Ellis, Jr., formerly assistant to the general manager, was appointed to fill the newly created position of assistant general manager and will assume the duties formerly assigned to the operating manager in addition to other managerial duties.

Mr. Pulley joined Gulf Power in 1925, after three years with Alabama Power Co. He became chief engineer of the company in 1935 and operating manager in 1947. He is a registered professional engineer and a fellow of the AIEE.

MEN OF POWER BRIEFS

UTILITIES

Duke Power Co. has announced the following promotions: **J. E. Chapman,** manager, maintenance and construction dept.; **E. B. Shuler,** manager, transmission lines dept.; **W. T. Reeder, Jr.** succeeded Mr. Shuler as superintendent, transmission lines dept.

Kenneth P. Locke has been named an assistant comptroller of the Detroit Edison Co.

Management changes at Central Illinois Public Service Co. include **Howard E. Stites,** named manager of the electric dept., and **Edgar E. Schmidt,** electrical engineer.

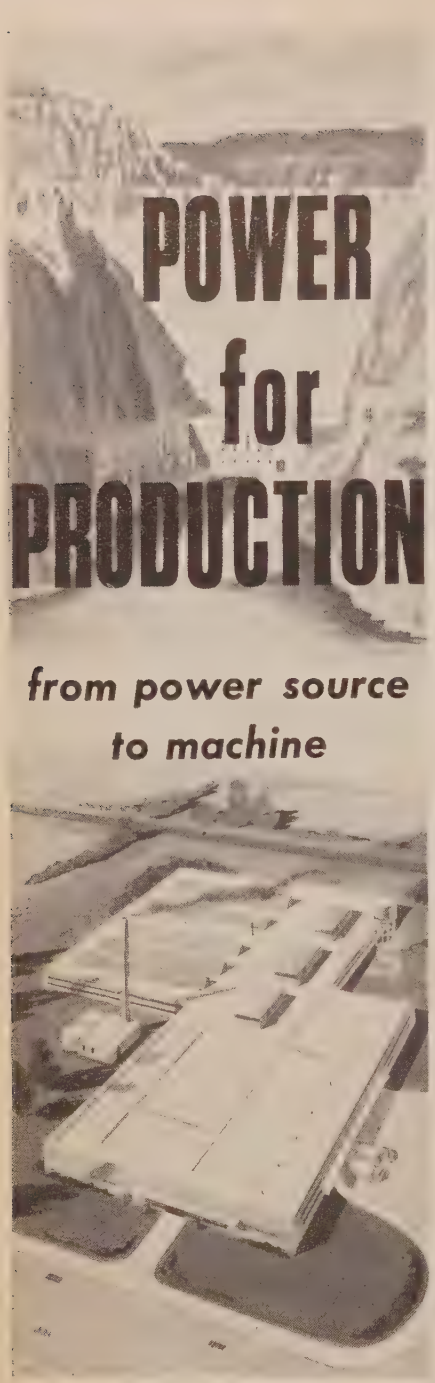
Charles S. Betts, Jr., former Potomac district manager of the Virginia Electric and Power Co., has been named assistant to the president of the company.

A TULSA® WINCH CAN TAKE IT!

Stronger . . . more durable . . . greater operating efficiency . . . easier installation . . . that's the Tulsa Winch! And Tulsa Winches are so versatile. There's one designed for every purpose. Whether it's the big job or the small job, the Tulsa Winch can more than take it. Immediately available through the world-wide sales-service facilities of our dealers and distributors. Ask to see our line.

- RESERVE STRENGTH
- LONGER SERVICE
- WORLD-WIDE DISTRIBUTION

TULSA PRODUCTS DIVISION
VICKERS INCORPORATED
Division of Sperry Rand Corporation
731 E. First Street
TULSA 20, OKLAHOMA



from power source to machine

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Quality . . . all along the line . . . has been a Hoosier tradition for over 40 years. Take advantage of Hoosier's "*complete circle*" service for all phases of your transmission, distribution or power plant needs.

HOOSIER
ENGINEERING CO.
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Two new positions have been created within the treasury and accounting departments of Arkansas Power and Light Co. and have been filled by long-time employees. **W. Allen Mebane**, a 22-year veteran, has been named manager of accounting, and 32-year employee **J. D. Doyle** has been named controller.

Mel D. Kennedy, formerly manager of sales, marketing and public relations for Ebasco, has assumed the post of director for the newly expanded Electric League of Southern California in Los Angeles.

John S. Wells, assistant to the vice president and general manager of Wisconsin Michigan Power Co., was recently promoted to assistant vice-president and assistant general manager.

Recently appointed division manager for Wisconsin Public Service Corp. at Green Bay was **R. J. Heins.**

New western division manager for Puget Sound Power & Light Co. is **W. W. Quistorff. J. W. Richardson,** former assistant to the executive vice president succeeds Mr. Quistorff as superintendent, western division.

New promotions at South Carolina Electric & Gas Co. include **Virgil C. Summer,** superintendent of production and **John P. Connolly,** superintendent, McMeekin steam generating station.

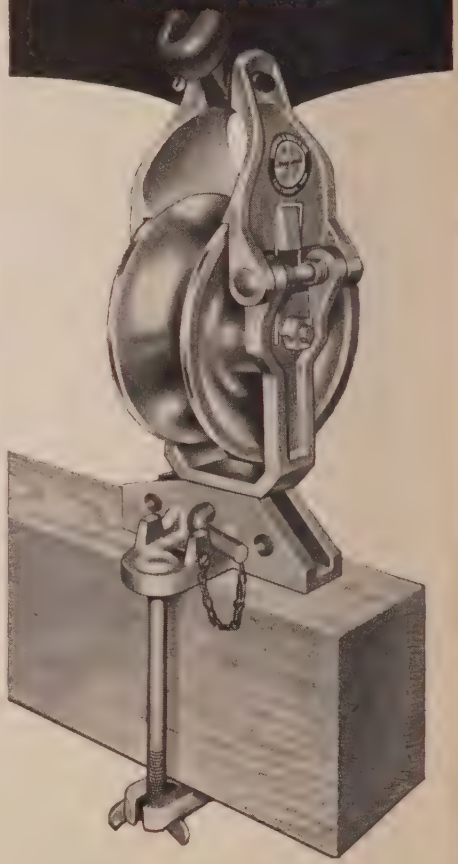
Virgil K. Rowland has been named assistant to President Walker L. Cisler at Detroit Edison Co.

Herbert R. Waite has been upped to the post of public information director for New England Electric System. He succeeded **William J. Codigan** who was transferred to NEES subsidiary, Worcester County Electric Co., as assistant to the president.

Florida Power Corp. has promoted **Edgar H. Dunn, Jr.,** assistant general counsel.

Appointed supervising mechanical engineer by Burns and Roe, Inc. is **E. Bradford Ripley.**

S&R Universal Stringing Sheave
MODEL XS-100



USE on CROSSARM as shown

USE on ANGLE for cornering block

USE without BRACKET to suspend from insulator stringing

Light weight, adjustable bracket, tough aluminum alloy throughout, safety locking, wide throat and anti-friction bearings. Grooved for cable through 1 ¾" diameter. Designed especially for ACSR.

NEW CATALOG
on complete line of S&R Conductor Stringing Equipment sent on request.

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Telephone AMherst 7-1273
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Crapo

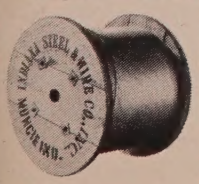
GALVANIZED STEEL STRAND HAS ALL 5

1. Strength
2. Workability
3. Ruggedness
4. Long Life
5. Economy

When you select a size and grade of strand for a specific job you want to know that it meets every requirement of that job. You want ample strength to sustain the ultimate load—plus an adequate safety factor. You want pliability for ease of working in the field. You want ruggedness to withstand the abuse which may be encountered during and after installation. You want long, dependable life. And, you want reasonably low first cost and low maintenance costs.

For more than 50 years *Crapo* Galvanized Steel Strand has consistently demonstrated its ability to more than meet all of these requirements. Proof of its reliable performance is to be found in the case histories of overhead power and communication lines throughout the country.

Crapo Galvanized Steel Strand is fully protected against corrosion by heavy, uniform, dense coatings of commercially pure zinc tightly bonded to the individual wires. All grades and sizes are available in A, B and C weights of coating.



For details, ask our distributor or write direct!

INDIANA STEEL & WIRE COMPANY, INC.
Muncie, Indiana

DISTRIBUTION LINE MAINTENANCE . . .

(Continued from page 77)

streets and highways on rainy days when outside forces cannot be given suitable indoor work.

Street lighting, which is not concentrated in large metropolitan centers, often presents peculiar problems. Our Company has about 54,000 street lights scattered over 200 communities.

We have crows-nest ladder trucks located in each district and schedule group replacement on a 2000-hr basis, using 3000-hr group replacement incandescent lamps. Mercury vapor and fluorescent lamps are replaced every two years, or at about 8000 hr. Enclosed luminaires are washed annually.

We have attempted to attain a low spot replacement of premature burnouts of incandescent lights between group replacement cycle and have reduced the replacements from 26 percent to 19 percent in one year, but these percentages include breakage due to vandalism. We have tried new gasket materials, bumper pads on sockets, and correct size film cutouts in series lights, and while we have reduced the large lamp burnout to about seven percent, the 2500-lumen series lamps, and the 189-w and 295-w multiple lamps continue to have a consistently higher burnout rate than the larger lamps. We believe this is partly due to the small-sized lamps having poorer quality control in manufacture, together with the fact that overcurrent, or overvoltage as the case may be, causes these smaller lamps to deterioriate faster. We are concentrating now on setting our series circuits at 6.5 amp instead of 6.6 amp, and we are experimenting with 130-v lamps in the smaller multiple group. Our nominal residential voltage is 120 but on the distribution circuits, the voltage at the transformer often varies between 118 to 126 v, and we now purchase 125-v group replacement lamps.

We have also begun, on an experimental basis, to use the services of a contractor to wash and group-replace our street lights in our three larger districts. Since this contractor is a specialist in this work, the results so far have been very encouraging.

NO MORE DARK STREETS ...and you can prove it!

Shoot at it . . .
Weather it . . .
Drop it . . .
Light it . . .

UNBREAKABLE Fiberglass STREET LIGHT GLOBES

Tested and Approved by Recognized Standards Committees

- Shatterproof
- Lightweight
- Weatherproof

Over 20,000 in use . . . coast to coast — in small and large cities!

Stop costly vandalism with these sensational new fiberglass globes. *Excellent light transmission properties.* Save replacement labor and cost. Protect pedestrians, automobiles and work crews. Weigh only 1/10th as much as a glass globe. May be stacked without breakage.

Available for all major types of luminaires.

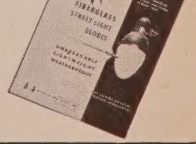
NO BREAKAGE FROM BB'S, PELLETS, OR ROCKS

No penetration from rocks, BB's or pellets. Small arms fire will enter but not shatter.

HOW TO GET YOUR TEST GLOBES

Write today on your letterhead for details on no-cost test program. Give luminaire make and model.

Complete brochure available on request.

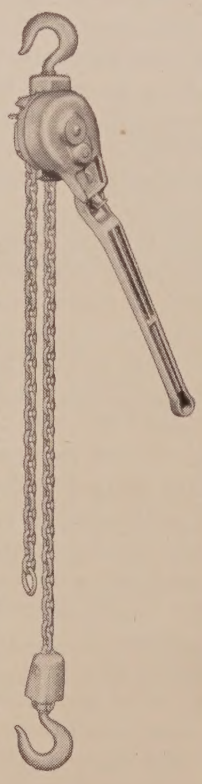


COMMERCIAL PRODUCTS DIVISION
PLASTIC AGE MFG. CO.
14300 DAVENPORT ROAD
MINT CANYON, CALIFORNIA

SUPPLY FACILITIES

Now on the road is I-T-E Circuit Breaker Co.'s mobile exhibit of newly-designed 4.16-kw switchgear. The 44-ft mobile unit is giving practical, on-the-spot demonstrations of the recently-introduced equipment to hundreds of customers and prospects in every state, except Alaska and Hawaii. Groups of from five to 15 persons have been attending two-hour sessions at each location. Given by field office representatives, the meetings consist of the showing of an 18-minute sound film, a complete demonstration of the equipment and a question-and-answer period.

AGAIN . . .
Coffing Brings You a New Line of Hoists



The new Safety Pull Aluminum Ratchet and Pawl Lever Hoist is easy to operate —requires minimum handle pull. It may be operated from either side, and the design prevents freezing a load.

Safety has been built into the hoist. It will not ratchet under load if handle is released nor will it free chain. Controls are protected from inadvertent shifting. The bottom stop eliminates any hazard from the handle being released unintentionally. The exclusive safety handle bends to indicate overload.

Strength without excess weight in the new hoist is achieved by a special aluminum alloy which is used in the body and handle.

Available in six models with capacities from ¾ to 6 tons. Ask your distributor or write for Bulletin ADH-86.

COFFING HOISTS
DUFF-NORTON COMPANY
Four Gateway Center • Pittsburgh 22, Pa.

Electric Bond And Share To Acquire Walter Kidde Constructors

Electric Bond and Share Co. has signed an agreement to acquire Walter Kidde Constructors, Inc., through exchange of stock. The exchange is contingent upon the acquisition of at least 90 percent of the the 17,380 outstanding common stock share of Walter Kidde Constructors and upon approval of the SEC.

Electric Bond and Share now owns Ebasco Services, Inc., and Chemical Construction Corp. The new acquisition, according to George G. Walker, president of Bond and Share, "will serve to make more complete the design, engineering and construction services that Bond and Share, through its subsidiaries, is equipped to furnish its clients."

No changes in operation of the new firm are contemplated at this time.

The Kidde engineering and construction firm was a part of Walter Kidde & Co., Inc., until 1929 when it became a separate corporate entity. Ownership of Walter Kidde & Co., Inc., is not affected by the acquisition.

Honeywell Announces Division Name Change

Minneapolis-Honeywell has changed the name of its Datamatic division to Electronic Data Processing division.

The change was made "to make the division's name clearly express its product line and to more closely identify these products with Honeywell," according to Paul B. Wishart, Honeywell president.

The name change does not involve any other reorganization in the division's operations.

Approve Simplex-Hitemp Merger

Stockholders of Simplex Wire and Cable Co. and Hitemp Wires, Inc., have approved the merger of Hitemp into Simplex. After the merger, Hitemp will operate as the Hitemp Wires Co., a division of Simplex. George F. Rolfe continues as president and general manager.

Burndy Forms Mexican Operation

Formation of a jointly-owned Mexican corporation, Burndy I.E.I. de Mexico, S. A., has been announced jointly by Burndy Corp. and Ingeneria Electrica Industrial, S. A., prominent electrical manufacturer in Mexico.

The agreement, similar to those entered into by Burndy in both France and England, provides for licensed manufacture and sale of Burndy electrical connectors throughout Mexico and Latin America.

SALES BRIEFS

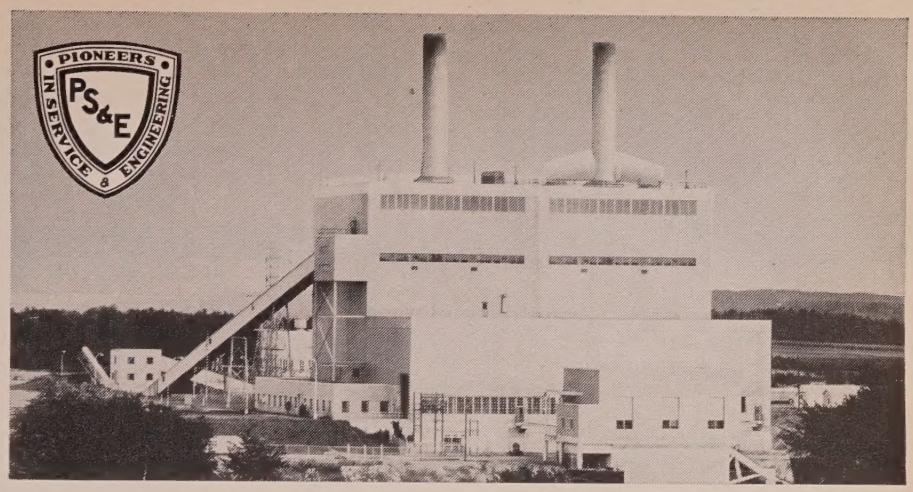
Michel Brothers, Los Angeles, Calif., have been appointed sales representatives for **Anchor Manufacturing Co.,** producers of meter mounting and service equipment lines. They will service the southern California, southern Nevada, and Arizona areas.

Tri-State Electric Co. has been named by **Arvin Industries, Inc.,** as a wholesale distributor for its primary electric heating systems. They will cover South Dakota, southwest Minnesota, and northwest Iowa.

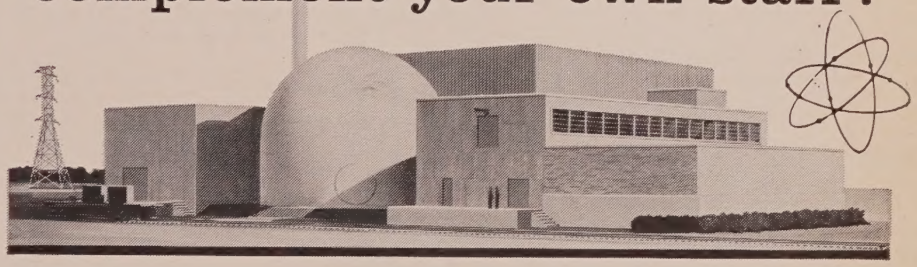
The sales department of **EMCOR Ingersoll Products division, Borg Warner Corp.,** has announced the appointment of **Harris-Hanson Co.,** St. Louis, Mo., as engineering-sales-representatives for Missouri, Kansas, Nebraska, and southern Illinois.

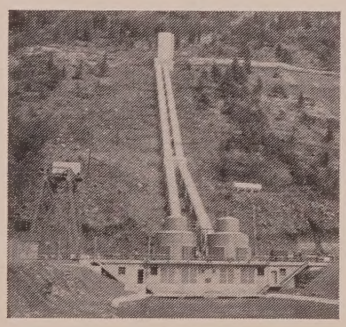
Allis-Chalmers has announced three new distributors. They are: **Straus-Frank Co.,** Electrical Supply division, San Antonio, Tex., distributor for A-C control equipment and transformers and agency for A-C regulators, power transformers, switchgear, unit substations and circuit breakers; the **Coghlin Electric Co.,** Boston, Mass., A-C motors, for Worcester County, and the **Hub Armature Works,** Lafayette, La., distributor for A-C motors and control equipment, for seven parishes around Lafayette.

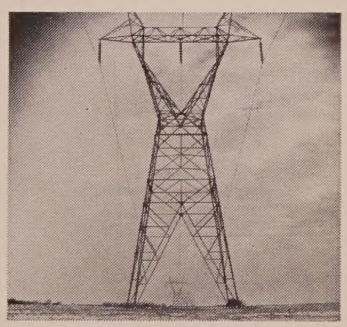
Midwest Piping has announced the opening of a sales office in the Park Building, Pittsburgh, Pa. William M. Bushman is in charge of the new office.



Which Pioneer service do you need to complement your own staff?







DESIGN AND CONSULTING ENGINEERING SERVICES

Pioneer specializes in designing power plants and offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and construction management. Pioneer's other services include substation, transmission and distribution studies and design.

SERVICES IN REGULATORY MATTERS

Pioneer offers its services in all phases of Federal, State and local utility regulation, including natural gas and electric rate matters, certificate proceedings, licensed project accounting requirements, depreciation studies for rate case and income tax purposes, cost allocations and special studies.

CORPORATE SERVICES

Pioneer offers its services as business and management consultants; stock transfer and dividend disbursing agents; financial, accounting and tax consultants.

Write for Booklet "PIONEERING NEW HORIZONS IN POWER"

Serving Electric Utilities and Industrial Power Users Since 1902

Pioneer Service & Engineering Co.

231 SOUTH LA SALLE STREET • CHICAGO 4, ILLINOIS

CALENDAR OF EVENTS

November 14-15—Pacific Coast Electrical Association, Administrative Services Section (Fall Conference), Phoenix, Ariz.

November 14-20—National Electrical Manufacturers Association: Generation, Transmission, and Distribution Equipment Division, Traymore Hotel, Atlantic City, N. J.; Insulating Materials Division, Westchester Country Club, Rye, N. Y.; Lighting Equipment Division, Waldorf-Astoria Hotel, N. Y.; 34th Annual Meeting, Savoy-Hilton Hotel, New York, N. Y.; Wire and Cable Division, Seaview Country Club, Absecon, N. J.

November 15-16—Edison Electric Institute, Area Development Workshop, Park Plaza Hotel, St. Louis, Mo.

November 16-18—Southeastern Electric Exchange, Sales Conference, Henry Grady Hotel, Atlanta, Ga.

November 22—Electric Companies Public Information Program, Inter-Regional Meeting, Detroit Leland Hotel, Detroit, Mich.

November 27-December 2—American Society of Mechanical Engineers, Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

November 28-December 2—24th National Exposition of Power and Mechanical Engineering, New York Coliseum, New York, N. Y.

November 30-December 1—Edison Electric Institute, Sales Division, Street and Highway Lighting Committee, Cincinnati, Ohio.

December 1-2—Pacific Coast Electrical Association, Administrative Services Section, Fall Conference, Hotel Safari, Scottsdale, Ariz.

December 5-8—Third National Conference on the Application of Electrical Insulation, Conrad-Hilton Hotel, Chicago, Ill.

January 19-20, 1961—Edison Electric Institute, Transmission and Distribution Committee, Baltimore, Md.

January 23-27, 1961—Doble Engineering Conference, Boston, Mass.

January 29-February 3, 1961—American Institute of Electrical Engineers, Winter General Meeting, Statler Hotel, New York, N. Y.

February 5-7, 1961—National Association of Purchasing Agents, Public Utility Buyers Group, Detroit, Mich.

INDEX TO ADVERTISERS AND THEIR AGENCIES